AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 9, No. 5. WEEKLY. | NEW YORK, JANUARY 30, 1886. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

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Novel Steam-engine Details.

We give below illustrations of some novel details recently introduced by the Straight-Line Engine Company, of Syracuse, New York, in their newly designed "short-stroke" engine.

Fig. 1 shows the elements that form the connection between the piston and shaft. The crosshead is in the main of the slipper-guide pattern shown in plan and vertical cross section in Figs. 2 and 3, but differs from the ordinary sort in the method of securing the piston-rod, and in the method of compensating for wear in the crosshead pin. The piston-rod is threaded into the crosshead, as is common with small engines; but in the place of the check-nut the end of the crosshead is split, and clamped on to the thread by two clamp screws, somewhat on the plan long used by the Buckeye Engine Company.

The chief advantages of the screwed-in method are that it admits of adjustment and is an ordinary machine job. The disadvantages are that it is a slow job to put it in, and that it requires the removal of the cylinder head to do it. To retain the one and overcome the other, the following plan has been adopted. The two sides of the rod are slabbed off to such an extent as to cut away fully one-quarter of the thread on each side, and the two sides of the thread are cut out of the crosshead to the same extent. By simply rotating the piston-rod one-quarter of a revolution, the crosshead can be drawn off. The piston rod is turned by a special wrench. The two clamp-bolts, as will be seen in Fig. 4, pass close to the slotted sides of the piston-rod, rendering it impossible for the rod to turn in use.

The crosshead pin is held fast in the connecting-rod by a clamp-bolt, as will be seen in Fig. 5, the bolt cutting slightly into the pin, to insure its proper location, and so locking it that its getting out is rendered impossible.

This arrangement gives the pin two bearings in the crosshead, in place of the one bearing in the rod, as usual.

The pin is very large, and to reduce weight and cost, the take-up is in the pin itself—that is, two loose pieces on the pin are forced out, to compensate for wear, in place of closing up the hole, as is usual for the same purpose. This is done, as will be seen in Fig. 2, by drawing two wedges together by a central bolt and check-nut. By this arrangement no weight is added to the crosshead, and the work is concentrated on parts easily machined.

The arrangement for adjusting the slipper guide, as shown in Fig. 1, is a very convenient one. The upper guides being secured to the lower one, they raise and lower together so that the guide can always be kept in line with the piston.

Fig. 5 shows the elements forming the connections between the eccentric and the valve. The method of connecting the strap to the rod is a novel one, and was specially adopted to bring the head of the bolts in a convenient position. The forked end of the eccentric rod straddles a hardened steel bush, as shown in Fig. 7, which is held in place by the central bolt. The valve-rod slide is, as will be seen, a complete crosshead, longer than the greatest travel of the valve, bushed with a hardened steel bush, and into which the valve-rod is threaded, and secured by a clamp-screw. The adjusting screw for the upper guide serves as an oil tube to convey oil to all the wearing surfaces. The valve-rod slide, being longer than the travel, always receives the oil from the oil tube, and channels cut in its upper surface convey the oil to the steel bushes, and the waste oil finds its way to the lower guide. The T headed coupling on the end of the valve-rod, fitting in the hooks cast on the valve, makes a connection that admits of the removal of the valve, without changing the adjustment.

The lower joint in the eccentric strap is set tight, and all adjustment for wear made by the upper stud. The spring of the strap is ample for all reasonable service. The lower joint being tight, prevents the escape of oil.

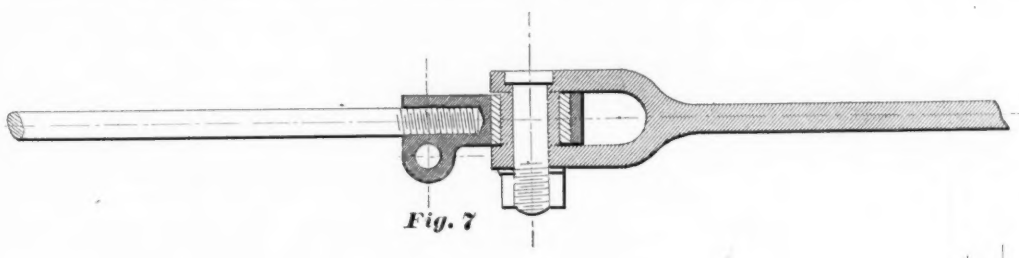


Fig. 7

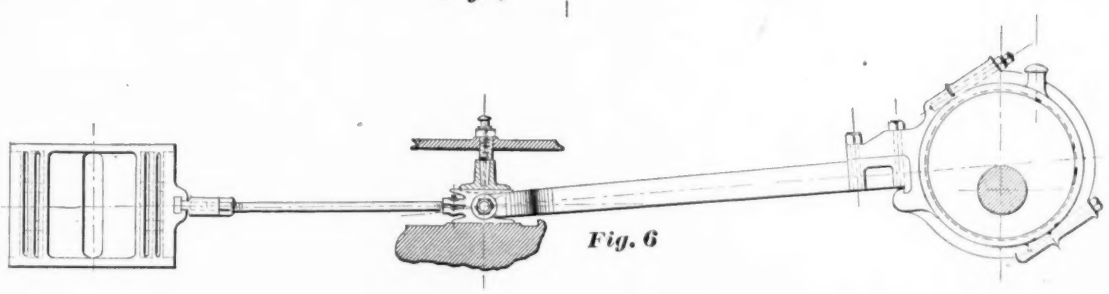


Fig. 6

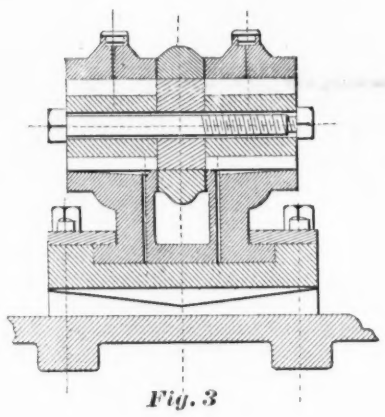


Fig. 3

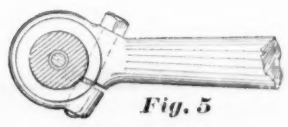


Fig. 5

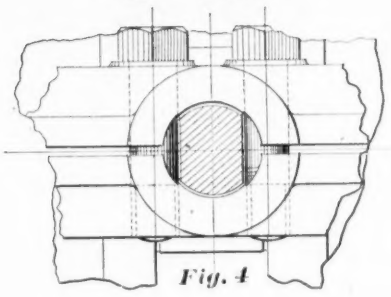


Fig. 4

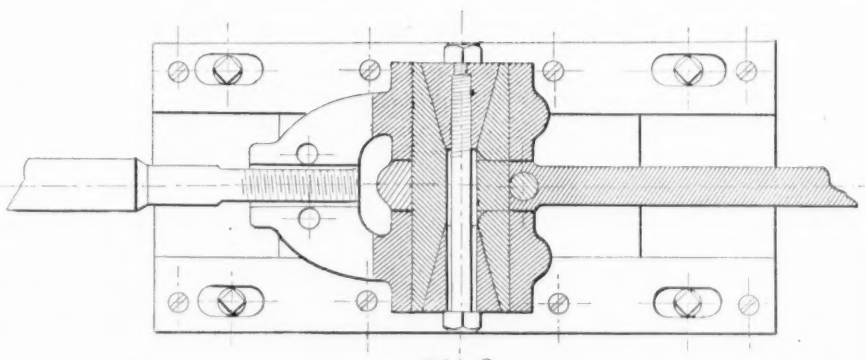


Fig. 2

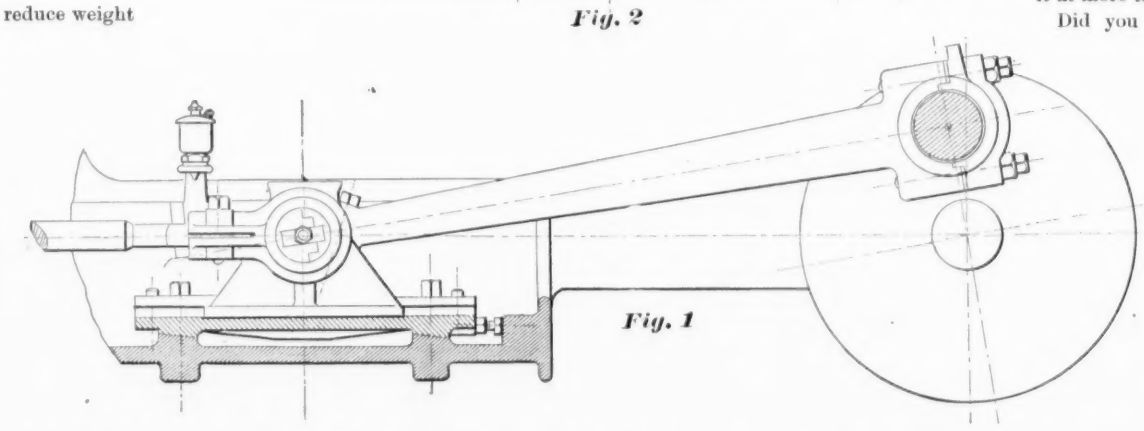


Fig. 1

An advertising agency proposes to issue a book entitled "Sketches of Great Papers," and offers the AMERICAN MACHINIST the privilege of posing as one of the papers of that ilk, on payment of one hundred dollars for one page or less, and fifty dollars for each additional page. We presume the greater the payment, the greater the paper, according to this method of estimating greatness. The AMERICAN MACHINIST does not estimate greatness that way.

In his recent message to the Legislature, Governor Abbett, of New Jersey, referring to convict labor, says:

I am satisfied that the "piece-price plan" recommended by the friends of labor and adopted by the prison authorities, is the best solution of this labor problem yet presented, and that it cannot fail of success under the management of those who desire that it shall succeed. Errors or mistakes may be made in introducing the system, but with experience there can be no real difficulty in making this system a financial success.

This sounds encouraging. The chief obstacle to rational treatment of prison labor questions has been the apparent determination of many public men to sustain the contract system at all hazards.

Pattern-making.

BY F. W. BARROWS.

SPIRAL AND V GEARS, AND WORM-WHEEL PATTERNS.

I am aware that it is the usual custom to true up the teeth of V gears by a straight edge, or sometimes by a bevel, which is worse yet, because it is impossible that the tooth should be correct and have a fixed bevel fit it at more than one point on the face.

Did you ever try to grind a plane iron on a stone that was cut down low in the center? Well, in trying to get the edge straight you had to hold it at an angle with the side of stone; then doesn't it follow that you would grind the iron hollowing if the stone had been true and you still held the iron at an angle? In the last case would not the edge of the iron be the same as the line formed by the intersection of the face of a tooth, placed at the same angle as the iron was held, and the rim of the wheel or pinion? Does not this show that you cannot true up the teeth by a straight-edge? Now, I propose to illustrate a way of getting around this difficulty in, as I believe, an original and accurate manner.

Let the figure represent half of a V-gear pinion of these dimensions: 2″ pitch, 6″ face (the Fig. is 3″ face); the angle or depth of V 2″. These dimensions are simply to save time and ink. To avoid confusion only one tooth is shown.

After the teeth are turned up and laid out on both sides (by the way, mark the center in the lathe if you haven't already, and drive a wire nail in both sides) then make your template as follows: You will need a piece of stuff 5″ long, 4″ wide and 2″ thick. Plane one side flat as *f*, *g*, *h*, then cut the block as shown by broken lines, making the curved side with a radius equal to radius of pitch line on pinion, having the edge *f* in a radial plane. Then make the piece 1½″ wide ½″ thick and 3″ or 4″ longer than from the center to top of tooth. The edge which is to be placed against the pinion should be beveled so as to touch the wheel only at the side next *c*.

This should be fastened to the block already made by screws nicely fitted, so they may serve as dowels. Plane the thin edge of *k* and the curved side of the block at right angles. After the right position has been fixed by the screws mark across the block along the beveled edge of *k*, then remove *k*, and draw a line across the curved side of block to meet the line across the edge *f* and square with *f*. Make another line parallel to and 3″ away from this first line. Lay off on second line 2″ from *f*, and draw a true spiral line from this point to where the first line meets *f*; work off the block to this line, which will be practically like the edge of plane iron when the stone was true, shown in the fig. by the curved line *a b*. The rest of the block may then be cut away so that it will go between the teeth, only being careful to preserve the angle on line *a b*. This line, in my opinion is the correct shape of face of tooth at pitch line.

The template will of course be correct only at pitch line, being a little too full towards the point and a little too flat nearer the root.

For a worm wheel the block would have to be curved on line *g h* to fit worm. If the teeth are to be formed in a core place a temporary center to hold the arm *k* against. If a large wheel with arms, better put them in before you turn up the teeth to guard against any possible change in the shape of wheel. You always work exactly to the center of a line. So if you would do an exact piece of work get your lines exact.

Ventilating an Engine Room—Uncovered Steam Pipes—Hot Feed Water—Grinding a Pump Plunger.

BY JAMES F. HOBART.

A method of cooling a hot engine-room, as practiced by some engineers, is to build wooden fans into the engine pulley, one fan between each pair of arms, at an angle of 45° with the plane of rotation. Box in the pulley as tight as practicable, fitting the boxing close as possible (without striking) to the belt. Leave a circular opening around the engine shaft. Let the diameter of this opening be about one-third that of the pulley.

Build a spout from any convenient part of the pulley case (opposite the inlet is best) to the outside of the building.

We recollect one concern which utilized the engine-room heat for warming part of their shop. They put up a line of 12″ tin pipe and carried the hot air where they wanted it.

It is not good policy to keep an engine-room at a comparatively low temperature, neither is 110 or 120 degrees desirable either for engineer or for the belts, however well it may agree with re-evaporation and other "cylinder evils," but not many steam users feel disposed to put in a ventilating fan or spend much money upon cooling appliances.

Engine-rooms which are so excessively hot as to require cooling when they have sufficient ventilation, may be set down as containing something wrong, either in uncovered steam pipes or in some other way, whereby a large surface of steam pipe is exposed to the atmosphere.

Many people adhere to a popular fallacy regarding feed-water heaters.

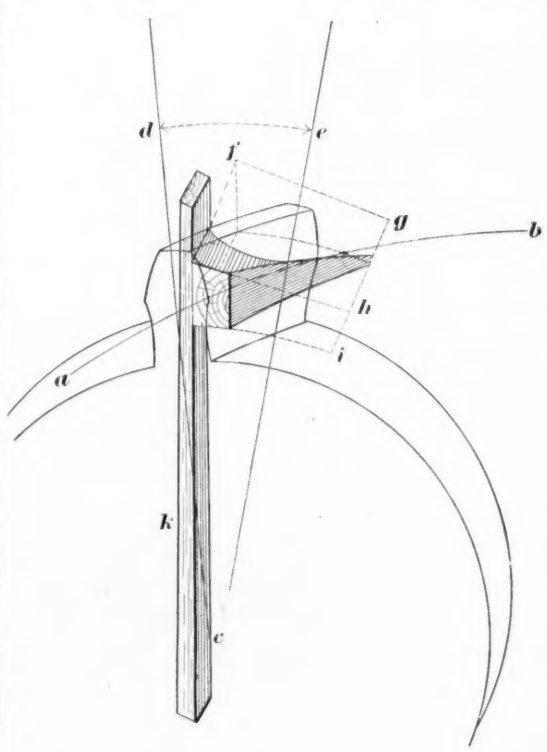
"Buy a feed-water heater," said a dealer in boilers and engines, "I have a heater that will beat anything you ever saw. I will guarantee to heat feed-water, with my heater, to 212 *and even to* 214 *degrees*."

When a man talks thus it is time to look into the matter more closely.

Exhaust steam, as it passes into a heater with no back pressure, has a temperature of about 212 degrees. How then are we to impart a greater degree of heat to the feed-water than there is in the steam itself?

We may safely set it down, as a rule, that when a man talks of heating feed-water, to such a degree, with exhaust steam, we may tell him he imposes back pressure on our engine, unless the feed water holds in solution, soda or some other chemical, which allows the water to be heated to a point considerably higher than 212 degrees before it is vaporized or turned into steam, a device sometimes resorted to.

The "Soda Engine," of which so much is being heard, principally from France, is operated upon this method, *i.e.*, the water is



heavily charged with soda whereby its boiling point is raised above 212 degrees, enabling considerable heat to be imparted to water which comes in contact with the vessel in which the sodas olution is confined. By these means the "heater buyer" may be imposed upon, and a feed water heater may really heat the water to even 220 degrees.

Doing a grinding job in an ordinary machine shop, in a common lathe, is not as easy as some people suppose.

Try to grind up a cast-iron plunger for a pump. It is 3½″ in diameter and 15′ long.

Rig it in the lathe with an emery wheel on the slide rest, and grind once across in good shape. Just then a man walks into the shop carrying a 50-pound crosshead. He drops it in the middle of the floor; this causes our grinding wheel to dig into the work, and a bad hole is left there after the job is finished.

Next, after setting the wheela boy runs into the shop and across the floor. At every step the floor vibrates, and we must run back the wheel or spoil the work. As soon as we again get the wheel to work, we must watch a man who acts as if he were intending to jump up to run his lathe belt on a larger step of the overhead pulley. While we are watching thus, another man will climb on a bench, fix a window, or get something from a shelf, and jump down on the floor again, making another hole in our pump plunger.

Every sudden jar will spring the lathe or emery wheel connections in such a shop, and the wheel will cut too deep.

Solid foundations will cure this trouble; nothing else will. A steady, even motion like that caused by an unbalanced pulley, will not trouble as much as a sudden jar, but it is just enough to keep the work from being exactly true.

Crystallization or Granulation?

BY S. W. GOODYEAR.

In the reported discussion of a paper which was presented by Wm. Hill, at the Boston meeting of the American Society of Mechanical Engineers, which is to be found in the AMERICAN MACHINIST of Jan. 9, 1886, there is much of interest to the plain, practical mind of the mechanic, who is daily wrestling with problems of more or less moment, in relation to the strange behavior of iron and steel, when subjected to repeated shocks and vibration.

In the theory which Mr. Hutton advances, that "a bar is made up of crystals interlacing and overlapping on the ends," the writer recognizes almost a repetition of his own language, which he first used nearly twenty years ago, in trying to explain to others a theory of his own, which had resulted from efforts to answer the "why?" which was being continually raised by the fact that cold swaging increased the toughness—the quality of bending without rupture—in either steel, iron or brass. That pieces of wire which would break before bending to a right angle could be, without annealing, without heating, put in a condition to bend double, and that, too, by the very thing—cold working—which was expected to increase the tendency to break, seemed strange, and for a time the writer, in common with others, felt disposed to charge to mere coincidence what soon asserted itself as a plain, undeniable and unvarying fact.

Many suggestions were made, among others, I remember as coming from one whose acquirements, metallurgically, entitle his opinions to the highest respect, this: "I believe that you get up heat enough by swaging to produce a low condition of annealing." On having placed in his hand direct from the dies, however, a piece of steel which a reduction of one-sixteenth inch had hardly warmed above the temperature of the surrounding atmosphere, he readily abandoned his position, and listened to my explanation, which was this in substance: "By elongation, overlapping, interlacing of the particles composing the mass, as shingles overlap on a roof, or interlacing like this—as the fingers of each hand were interlaced with those of the other—the pieces of metal acted upon are made *more tough* without being made *more soft*." Thus I have explained to my own satisfaction hundreds of times the phenomena which were so striking to those who had felt sure that cold-working lessened the bending quality of metal, however much it might increase the tensile, torsional or transverse strength. Added to this overlapping, interlacing of crystals theory was another of equal importance, perhaps. By a process which brought all parts of each piece acted upon under the same compressive force, there was a uniform molecular condition established from circumference to center.

That a piece of high-carbon cast-steel wire could be taken in its half-hard condition, as it came from the drawing-die, and without heating or annealing, could be swaged down from 0.80″ diameter to 0.25″ diameter, and still be tough enough to tie in a knot and pull up tight, like string, was at least evidence that excessive working, cold, even, if properly done, did dot destroy the bending quality.

Just here I will stop and tie a knot in such a piece, as above described, and enclose it herewith, for the inspection of the curious who may occupy or visit the office of the AMERICAN MACHINIST. I have the knot tied at the first attempt, with no selection of a good piece, but taking the first which came to hand.

[In the specimen referred to, the knot is about as perfect as could be tied in a string of the same diameter.—ED.]

"Well, what of all this?" does some impatient reader ask? I answer that the discussion referred to, in which we have the opinion of Prof. R. H. Thurston, than whom it is probable no other person living is better qualified to judge, either from a scientific or practical point of view, has prompted me to attempt to put in readable language some opinions which I have long held in relation to so-called crystallization of iron or steel, which is believed by many to take place at ordinary temperature, and wholly through the agency of shock or vibration. That steel and iron are both crystalline, it seems to me, are self-evident. That the peculiar character of iron, which, if bent to breaking, shows a fibrous fracture, or, that, owing to its peculiar structure, as compared with steel, the crystals are elongated and interlaced to such a degree as to show by etching an apparently fibrous structure, does not prove the existence of a fiber, a grain, as in wood, against the fact that the same irons which show the most unmistakable fiber, may be broken by sudden shock, short off, and show a fracture as truly crystalline as that of pig-iron or ingot-steel: or, without the shock, a succession of slight deflections in different directions will produce the same effect.

My belief is, that in very many cases the condition of unsafe crystallization which is noticed when fracture occurs, and which is so readily accounted for on the ground of alleged shock and vibration, existed in the bar or sheet from the moment when it left the hammer or rolls, and that in the cases where shock or vibration have really stood as the apparent cause of a change in structure, causing breakage, a close analysis will show that some more potent influence than mere vibration has been at work. It is very easy to charge to the jar and vibration in the steam-hammer the short life of "hammer-rods," but when we consider the conditions under which the majority of the blows fall upon the piece under treatment, with the full first-force of the blow delivered by one side, or end, of the hammer face, whose area is ten times that of the rod by which the blow is struck, thus causing a side strain upon the rod, which comes with a suddenness that vastly multiplies and intensifies its effects, why should we persist in calling the force which it is expected will break the rod simply "jar"? The rod might be taken from its place and laid horizontally on an anvil with its hammer-head overhanging, and two men set at work to break the rod by pelting the hammer with sledges, and the effect of the blows would be no more directly to break the rod than when in use the hammer face is compelled to climb up a succession of steps of its own making. If, in practice, the hammer face at each blow found a level bearing, and for an equal distance in all directions from the central rod by which it is driven delivered a blow of equal force, or the force of the blow met with equal resistance for the area named, there would be a condition conducive to long life; but, as the case really is, the wonder is that "hammer-rods" last as long as they do. A line shaft sometimes breaks in use, which shows a fracture so decidedly crystalline as to puzzle the believers in constitutional, chronic, progressive crystallization. Whence come the shock and vibration to produce such structural demoralization? Of course there are the thud, thud from some unbalanced pulleys, and the tremor from some meanly-working gears, but they hardly furnish grounds for laying the whole trouble to shock and vibration. Just here comes in the practical machinist—that *enfant terrible* of the scientifically mechanical family—and says: "Don't you see what broke it? It was out of line, and at each revolution it was necessarily bent in all possible directions successively, until the loosening up of the particles composing the mass caused rupture."

It would be too much tax upon the patience of readers to bring to light the causes for weak, coarsely crystallized or granulated places in bars or sheets, which should be, on general principles, alike all through, or to point out reasons why from 1 to 50 per cent. of a given lot of bars or sheets should prove of no value, while the others answer all the requirements, and still are supposed to have

been made from the same material, and in precisely the same way, of those which fail.

Let us, however, suppose a few cases. In the case of iron bars, or sheets, which result from the piling, welding, building-up process from muck-bar, will not even a casual observation of material used and methods employed disclose the plainest of reasons why there may be, must be, in many cases, weakness of structure in some parts of the product as compared with other parts?

First, the bars themselves are of the most irregular structure imaginable, with some parts reasonably sound and solid, other parts spongy and porous. Clean, good stock at one point, and full of impurities at another; at places longitudinal ruptures give the appearance of bundles of strands, as in a demoralized rope, while at other places a lack of the fibrous formation is compensated for by divers yawning, irregular, transverse cracks, which leave the bar literally composed of hundreds of sections, joined to each other by the barest points of contact, which will suffice to constitute a continuous bar. Is it not plain to see that in piling together a bundle of pieces cut from such bars, and bringing to a welding heat, there must be a difference between those parts where sound iron coming in direct contact welds at the first blow, or at the first pressure of the rolls, and gets the entire benefit of the work applied, and those parts in which longitudinal interstices and transverse gaps and chasms are to be closed, and their ragged walls welded by extension in length and contraction in section, rather than by immediate direct pressure? How about the gap of an inch, perhaps, in the center of the pile, which is made by putting two short pieces end to end, in place of a full-length piece? It may weld up sound, and it may not. If it does, is it not easy to see that it does so by a gradual process of reaching out towards each other of the separated ends, and a closing down into the chasms of the surrounding pieces, which, if not precluding the possibility of as sound a weld, certainly render impossible the same degree of judicious working which takes place where the contact is perfect in the beginning?

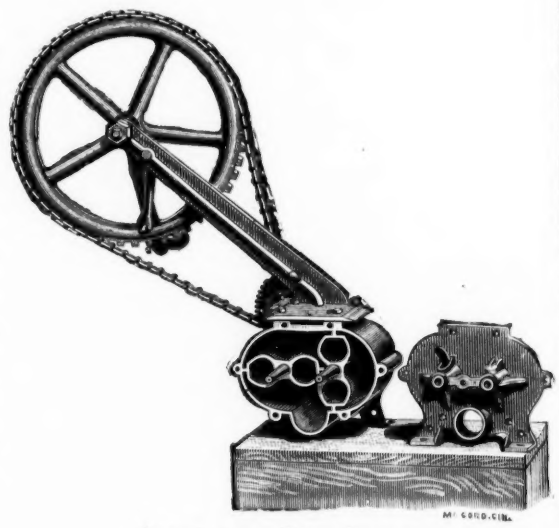
Again, in the building up of a large shaft from billets or blooms, is it not plain that this same risk of not thoroughly welding and judiciously working those parts of the mass which fail to come in contact until indirectly brought together by work applied to other parts, is even greater than in the case of piling and welding the pieces of muck-bar? Added to the above possible causes to which may be charged some of the lack of uniform structure in wrought iron, are uneven, injudicious heating, insufficient heating for much work, and excessive heating for little work, too light blows, which only affect a portion of the mass, and too heavy blows, which, to use a very inelegant expression, "squash the very life out." These last-mentioned abuses are as prevalent in the working of steel as in working iron. Prof. Thurston makes the evils attending insufficiency of blow to move the entire mass, and heating to a high heat without subsequent work enough, very plain in his allusion to the difficulties accompanying "the building up of a large shaft."

My long familiarity with cold working and forging in a small way, with some opportunities for observation of the methods practiced in larger work, have convinced me that when told that certain results will follow certain treatments as a direct consequence, it is safe to answer, that depends upon conditions. Uniform structural condition, uniformity of working, uniform, even judicious heating, discrimination between shock, jar, vibration and the most destructive character of side strains and combination of torsional and transverse strains, would, in my judgment, cancel so many of the charges to the account of progressive crystallization and disorganization of structure as to leave us at a loss to find a case which could be proven.

If piece after piece of steel, of common iron, and later, of the toughest, most fibrous (?) iron procurable, have been broken, supposedly by crystallization, in a machine where a rapid succession of shocks and constant vibration gave ground for the supposition, until the only alternative seemed to be to replace, *the jar would break them anyhow*, and later it was found that, owing to defective alignment, there have been a succession of transverse strains upon the breaking pieces, which, in their varying positions, have been taking these slight deflections in all possible directions at the rate of half a million times a day, and the alignment being made perfect, the breakage of the pieces made of either iron or steel entirely ceased, although the shocks and vibrations continued, of course the crystallization theory would be dropped for that particular case; ought it not also to lead to more careful investigation in other cases which might prove identical in their main features?

Roots' New Acme Hand Blower.

The blower shown in the accompanying illustration, while freed from complication, will produce, notwithstanding its small size, a blast of great strength and volume. The revolvers are enclosed in an iron case, only 12″x9″x8″ in size; they are of iron, and are dressed so that they will keep up perfect and continuous contact with each other, and with the case during the entire revolution, thus forcing forward and utilizing all the air taken into the case. The shafts are made of the best steel, and the boxes of phosphor bronze, so arranged that they can be easily renewed. The oiling arrangements are very efficient. The gears are accurately cut; they are inclosed in oil-tight housings, and run constantly in oil so that the wear is reduced to a minimum. The machine is driven by chain wheels and belting, and the speed multiplied by cut gears. The blast is discharged on the under side near the end, and taken to the tuyere in a pipe with only one elbow. These blowers are manufactured by P. H. & F. M. Roots, Connersville, Ind. S. S. Townsend, general agent; Cooke & Co. are selling agents at No. 22 Cortlandt street, New York.



ROOTS' ACME HAND BLOWER.

Graphite.

FROM A CHAPTER CONTRIBUTED TO "MINERAL RESOURCES OF THE UNITED STATES," BY JOHN A. WALKER, SUPERINTENDENT DIXON CRUCIBLE COMPANY, AND PUBLISHED BY THE GOVERNMENT PRINTING OFFICE.

The last few years have witnessed a great improvement in American foundry practice. From the comparatively light, simple and rough casting of the earlier days, the time has been reached when immense castings are of frequent occurrence, in which the work is often elaborate and the finish very high; in fact, castings are now produced at will, light or heavy, smooth or rough, plain or ornate, of common, chilled, or malleable iron, steel, etc., and all of these different conditions require different service of the facings. Instead of the simple hard-wood charcoal-dust of earlier times, facings of charcoal, sea coal, anthracite, soapstone, and "black lead" or graphite are now used. In all cases where the work is severe, graphite is the constituent which gives the "body," the "sleeking" and "peeling" properties, to the facing. The use of graphite for this purpose has increased rapidly with the demand for better and finer foundry work.

Water-dressed dry foliated American graphite is a little thin flake of graphite of extraordinary properties. Its superiority as a lubricant has been attested by all recent writers on friction. Its coefficient of friction is very low. Its enduring qualities are several times greater than those of any oil. Unlike either oil or grease, it is not affected by heat, cold, steam, acids, etc., and acts equally well under varying conditions of temperature and moisture.

Many and carefully conducted experiments in the laboratory with Professor Thurston's testing machine, and experience in shops, have shown that, for the highest usefulness the flake must be of a certain size and dressed perfectly pure. Graphite never occurs of the proper size and purity for use. Its natural impurities contain substances fatal to anti-friction purposes. Its proper selection, sizing, and perfecting for lubricating purposes is a matter requiring large skill, much machinery, and great experience. The difference between a perfectly pure graphite and one almost pure, but still totally unfit for lubricating, cannot be detected by either sight or touch.

It is recommended dry for steam and air cylinders, mixed with grease for heavy bearings, and mixed with oil for light bearings. On being applied to a bearing, it readily coats the surfaces with a shiny, unctuous veneer. The surfaces then slide on each other with very little friction. On being applied to a heated bearing, the graphite soon fills up any inequalities of the bearing surfaces due to cutting, abrasion, etc., making them smooth and even, after which the bearing soon cools down. It is equally useful for wood or metal surfaces; in short, in all cases where friction exists. If the bearings are loose enough for the introduction of this thin flake graphite, it will prevent heated bearings, cool those already heated, and reduce friction better than anything else. In all cases where the service required of a lubricant is very severe, graphite will be found specially useful, as in mill steps, gears, heavy bearings, bed plates, etc.

San Francisco's Experience in Running Cable Roads.

According to the San Francisco *Mining and Scientific Press*, the Sutter street road was opened as a cable road late in the summer of 1876, using Hovey's lever grip, but with Paine's combination of grip rollers and brakes on the same, instead of solid jaws. The grades on that road are only seven per cent., but a great deal of trouble was experienced with that grip. The rollers operated like a rolling mill, and lengthened the cable rapidly by the great pressure required being confined to a small surface, and also broke up the surface wires rapidly. When the loads were large, the gripman could not exert force enough on the lever to prevent slipping of the cable through the grip. In less than six months from the time the road was opened as a cable road, all of Col. Paine's brake rollers had gone to the scrap heap, and none has ever been used on that road or any other in San Francisco since that time. The grade on the California street line, from Dupont to Stockton streets, is 18.2 per cent., and on the next block but slightly less. The car and dummy used on that road weigh something over 8,500 pounds. Sixty passengers are not an unusual load (110 having been carried up that grade at one load), which, at 125 pounds each, would make the total weight of loaded car and dummy 16,000 pounds. Such a load can be found every day, about six o'clock in the evening. The resistance due to friction, at the rate of 40 pounds per ton, as before, would be 360 pounds. The resistance due to the lift on a grade of 18.2 per cent is about two-elevenths of the total weight, equal to 2,900, making the total resistance 3,260 pounds, which is considerably greater than that encountered on the Brooklyn Bridge. Yet the grips give no trouble, and there is no possibility of the cable slipping out of the grip on the grade, and one cable has run more than twenty-two months on this line. It is frequently necessary to stop on that grade, but the car is held securely by means of the rail safety-brake, which is free from all complication; but, on the Brooklyn bridge, if the ascending cars are stopped by any obstruction, they are required to back down to the crossing of the street below, before starting, to avoid damaging the cable. On the Clay st. hill road, near by, the grades are about the same, but the cars are not quite so heavy. The Clay street was the first cable road ever constructed, and has been in operation more than twelve years. The Sutter street cable road has been in operation nine years; the California street nearly eight years; Geary street cable road, six; Union street cable road, five; and the Market street road, which is through the most important and busy street in San Francisco, about two years and four months. The safety rail brake is conceded essential to all roads having steep grades, and is used by all the cable roads here except the Geary street.

We are aware that it is much more severe on the cable starting a load of 52,000 than 16,000 pounds under the same conditions, but the Brooklyn Bridge cars always make the start at the same places, and only have to start twice on a round trip, and it would be an easy matter to make the track down-grade in the direction of the travel for a distance of 50 or 75 feet at the starting places; while on the Market street road of San Francisco, cars are required to stop anywhere a passenger may desire to get on or off, so a car frequently makes forty stops and starts to each round trip, and half of them on some up-grade.

There is no trouble for any experienced gripman starting without any severe shock, but they must start quickly to make the time between terminal points with the large number of stops for passengers they are required to make. On the branches of the Market street road leading to the park the grades are $12\frac{3}{10}$ per cent. The cars weigh 10,000 pounds each, and have carried up that grade as high as 151 passengers, making a total weight of over 28,000 pounds. The cars are only two minutes apart on Sunday, and the average load of all the cars going up the grades for an hour, by actual count, was 116 passengers.

It is frequently necessary to stop on these grades, and if these cars had to depend on wheel brakes alone, collisions would be frequent, as a car will slide down such a grade on a slippery track with all the wheels locked, when once in motion, so the safety brakes are a necessity.

There is a feature of the Bridge arrangement that cannot be too severely condemned, as being unhandy and dangerous. That is, the hitching of the grip and brake together on the same operating mechanism so that the wheel brakes even cannot be applied until the grip is released. The brakes should be entirely separate from the grip operating mechanism, and a lever is preferable to any hand-wheel and brake-staff when a man is excited, for the reason that the motion required to apply the brakes by means of a lever is quick, direct and unmistakable, far more so than can be obtained by any other motion.

If these gripping and brake devices used on the San Francisco roads were new and untried, or only existed on paper, the case would be entirely different, but after from six to twelve years of constant every-day use of these devices on six roads in San Francisco, on grades more than five times as heavy as those on the Brooklyn Bridge, and one of these roads has carried over 70,000 passengers in one day, the action of the Bridge Trustees committee in establishing an office for the purpose of testing and passing upon the merits of such grips as may be presented, must have been taken without a full knowledge of the state of the art. Any office test is of little value, as compared with that of every-day use through a period of several years.

A Convenient Angle Plate.

BY A. B. LANDIS.

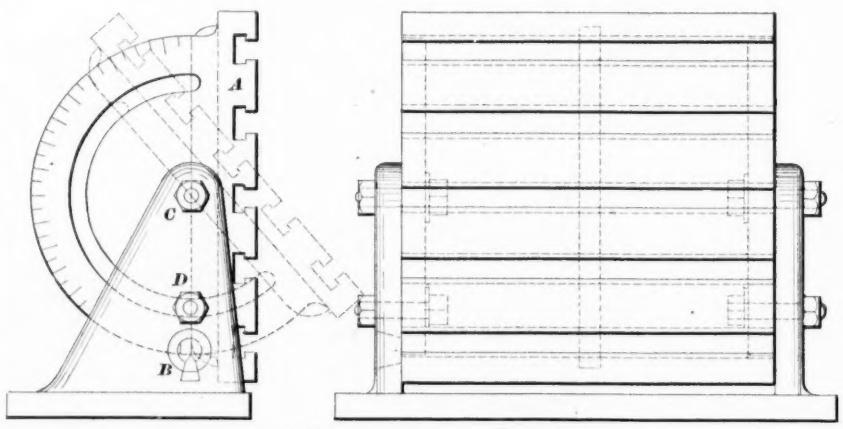
It is often desirable to chuck work at different angles, and at a given angle by degrees, for drilling, planing, or milling. The drawing I send herewith will give a clear idea of a device I made for that purpose after being annoyed when chucking work, by blocking it, and getting the angle by the use of the bevel protractor, which both consumed time, and in many cases was not a permanent chucking (owing to the blocking) until the job was finished. To overcome this difficulty I made an angle plate as shown, and it is a great satisfaction to use it. You can see at a glance what angle it is set at, by the graduated arc, and the angle can be quickly changed from one to another.

It is often desirable to drill holes into a piece of work at different angles, or to drill holes on the opposite sides of a casting in which the holes must be parallel with each other, or two holes to be drilled at right angles to each other, or any angle, which can be quickly done. I speak of such castings as are not surfaced on all sides. A casting that is squared up, can have this condition of the holes brought about without this plate.

The plate, as may be seen, will swing from 90° to 0, and from 0 to 90° on the opposite side. It is often desirable to plane or mill two or three given angles on a piece of work, which can all be done with one chucking, and quickly changed, and with a degree of accuracy that is desirable, provided, however, the angle plate has been accurately made. To accomplish this the plate must be centered at *C*, and have a hole bored the size required for the bolt, opposite holes on a line with each other, then insert a mandrel with good centers and face off the ends or arc pieces true and parallel with each other on a lathe, then put it on a pair of true planer-centers and plane the top off. Thus we have a true plate. Then plane the inside of the standards of base plate, square with bottom; bore the holes for the bolt on which it swings at right angles to this surface, and on a line with each, and the plate is true.

The arc can easily be graduated on the universal milling machine. A hole, *B*, exposes the graduation, and a pointer is inserted therein. Bolt *D* is loosened on both ends, as well as bolt *C*, in order to swing the plate. When the four bolts are again tightened, there is no danger whatever from slipping.

An addition can be made to this plate, of great advantage for use in milling, by putting an extra plate on the bottom, to form a swivel bottom, in order to set the plate at an angle to the travel of the platen of the miller when end milling work is to be done. This base can also be graduated, and thus any angle be obtained.



A CONVENIENT ANGLE PLATE.

Comparative Density of Solid and Melted Cast Iron.

In describing various instruments which were exhibited at the Inventions Exhibition (Eng.) *Engineering* says:

A question which has formed a never-ending source of discussion among iron founders, that is, the reason why a piece of solid cast-iron floats in a ladle of the molten metal, receives its solution by an apparatus shown by Mr. Thomas Wrightson, of Stockton-on-Tees. This was brought before the notice of the Iron and Steel Institute some years ago, but many of our readers may not have seen it. The apparatus consists of a tripod sufficiently large to stand over a ladle containing about half a ton of fluid cast-iron. From this tripod there is suspended by a chain a brass cylinder driven by clockwork, and carrying on its periphery a piece of paper on which a diagram is produced by a pencil, which rises and falls in accordance with the indications of a spring balance to which it is attached. From the spring balance there depends a rod carrying at its lower extremity the ball, the specific gravity of which, as referred to molten iron, is to be tested, and when the operation is progressing, the ball is suspended in a ladle of fluid metal. Before the trial commences, however, a zero line is drawn upon the cylinder to represent the point at which the solid iron is of the same specific gravity as the fluid. To obtain this there is attached to the rod of the balance, which ends in an eye, a piece of bar iron of exactly the same section as the stalk projecting from the ball, and of a length sufficient to reach to the surface of the bath. This draws down the balance, and if the cylinder be rotated a straight line is drawn. The ball is then attached and the whole apparatus is lowered by the chain until the stalk is submerged to the determined amount; the cylinder being set in rotation by clockwork at the same instant. Now, it will be evident, that if the cast-iron be of less specific gravity than the fluid metal, and therefore have a tendency to float, the ball will carry a portion of the weight of the rod depending from the balance and the pencil will stand above the zero line. But it has always been found (the experiments were made with Cleveland No. 4 foundry quality of iron), that the first tendency of the ball is to sink, no matter how carefully it is lowered into the ladle. It then begins to expand under the action of the heat, and in a short time it attains the same specific gravity as the bath. The expansion still continuing, it becomes buoyant and raises the pencil above the zero line, and finally it melts, leaving on the paper a diagram which is an exact record of the change it has passed through. At the moment when the expansion is at its highest point, the ball is so soft and plastic that it is possible to thrust a pointed rod of wrought iron through and through the mass, the consistency being similar to that of putty. The instrument shows that when passing from the solid to the liquid state, the density of the iron is at its maximum when cold, at its minimum in the plastic state, and that the density in the liquid state is between the two extremes, although much nearer the solid than the plastic density. The following table gives the results of four experiments.

EXPERIMENTS ON THE DENSITY OF PLASTIC CAST IRON.

No.	Diameter of Ball.	Weight, including Part of Stalk Immersed.	Maximum Sinking Effect.		Maximum Floating Effect.	
			Weight	Per-cent'ge	Weight	Per-cent'ge
	In	Oz.	Oz.		Oz.	
7	3	59¼	2	3.4	2¼	3.80
8	5	252¼	1⅛	.6	8	3.17
9	3	59	1¼	2.12	4½	7.60
11	4	132¾	¼	.2	6½	5.

The town of Scottsville, Pa., in subscribing to a new pipe mill, have made the company running the same, file bonds to pay their workmen in cash, instead of "company store" orders. This is a move in the right direction; no town should subscribe to induce a business to locate in their midst and then lose all the benefit that should accrue to their merchants by the company owning the business, paying their employes orders on a store owned by themselves; nor should the work-people of such companies consent to receive their wages Saturday night, with a string tied to it, by which their employers can draw it back during the coming week to pay it to them the next Saturday night. The "company store" is decidedly an anti-American institution, and should be abolished.—*Sewing Machine Journal.*

An Examination in Steam Engineering.

In the AMERICAN MACHINIST of Dec. 19, 1885, mention was made of a series of questions by C. L. Redfield and answers by E. D. Davis; as published in *Wood and Iron*.

We take pleasure in reproducing the answers to several of the questions. They do credit to their author, and at the same time we recommend all our young engineers to set about doing as well.

13. Give a rule for finding the diameter of a cylinder for any given horse-power.

A.—Multiply horse-power by 33,000, divide by piston speed in feet per minute and again by mean pressure in cylinder, and the result will be area of piston, which, divided by .7859, will give the square of the diameter.

17. What are the functions of the steam-engine governor?

A.—The functions of the steam-engine governor are to control the motion of the engine either by regulating the pressure upon the piston or by regulating the action of the valve.

19. How would you proceed to ascertain the amount of lap and lead on a slide-valve without opening the steam chest?

A.—The relative positions of the eccentric and crank will give the lap, if the valve has been properly set. Mark the middle of the throw of the valve upon the valve stem and some stationary part adjoining, and then place the engine upon its center; the distance between the two marks will be the lap, which will be too great by just the amount of lead. If after marking the valve rod the engine be placed where it commences to take steam, the mark will have moved as far as the lap. To find amount of lead, notice at what part of stroke the valve allows the steam to enter the cylinder, and then move the engine on, to its center; the distance the valve has moved between the two points will give amount of lead.

22. What should be considered in indicator diagrams as indications of good construction and performance?

A.—High initial pressure maintained to point of cut-off, a well defined curve nearly to atmospheric line, and as straight a line as possible on the returning stroke (the lower the better), nearly to the end.

29. Suggest a way for effecting the saving of some part of that immense proportion of heat which we have been taught to believe to be invariably and unavoidably wasted in the combustion of fuel.

A.—In the general improvement of steam boilers we can imagine our remote descendants looking back at our imperfect generators of steam. Almost all boilers in use at the present day are comparatively rude. Some efforts have been made to improve the steam boiler with some success, but it is not so much as we could wish. An experiment was once made to force the products of combustion directly into the boiler, but had to be given up on account of soot. All such experiments are worthy, and were they persisted in, with as much determination as is characteristic of north-pole seekers, we should soon have a vast improvement in steam boilers. Perfect combustion, which is a possible thing, should have but little refuse matter except that which would be found among the ashes. It is surprising what needless waste results from probably nine-tenths of the steam boilers in use. All efforts to heat feed-water by heat that must otherwise unavoidably pass off, are to be commended.

33. What is the law of movable pulleys?

A.—The power is doubled by each movable pulley when acting separately, but when two or more are bound together in one block, as in the common block and tackle, the power is multiplied by twice the number of movable pulleys or the number of pulleys in the movable block.

40. Give a ready method for being always able to prove the correctness of your steam-gauge.

A.—When steam is at some point not over half the usual pressure, place the ball on the safety-valve at the point where it commences to blow off and mark the place. Move the ball twice as far from the fulcrum as this mark, and it should blow off at twice the pressure as indicated by the gauge or it is not right. Any other relative distance may be used to advantage.

42. Does wetting coal improve it, or not, for the purpose of making steam?

A.—In a test, wet coal will be likely to fall behind dry coal for fuel, but in many furnaces of improper construction, steam, or even a little water, will lessen the amount of smoke, which shows that the combustion is more complete. It has been said, also, that it tends toward preventing the formation of carbonic oxide gas, if properly used. But in furnaces of good construction that yield a good combustion, water will do more harm than good. This is a disputed point.

46. State the principle involved in the working of the injector.

A.—The velocity of the steam being greater than that of the water, it acts with a mechanical advantage in the same way in which a small wheel acts upon a larger and slower moving one, introducing into the boiler less in bulk than was taken from it.

47. State briefly what you consider the most remarkable property of steam.

A.—One of the most remarkable properties of steam is its capacity for sensible heat. It requires more heat to heat a given amount of steam or water, than any other known substance, excepting hydrogen gas.

49. State briefly any considerations affecting the economical operation of steam-engines?

A.—The greatest loss in steam-engines is for the want of the proper set or make of the valves. Another loss of considerable importance is from want of proper covering for steam cylinders and pipes. Save all the waste heat possible. It is certainly far from being economical to hire cheap engineers, and it is folly to have a money-making institution with a money-wasting boiler and furnace, as many do who complain of hard times.

50. Have you any suggestions to make respecting the improvement of any part of steam-engines?

A.—There is much room for improvement in steam-engine valves. One thing I would suggest, that in engines, particularly small ones, the governor and steam chest and some other fittings about the cylinder be fastened on differently, say with bolts, either with a nut on both ends or a head and nut. Where small bolts are screwed into cast iron and left to the action of steam, and possibly grease, for a long time, they often occasion much trouble when it becomes necessary to remove them. In places where machinist tools are not kept at hand, the engineer is obliged to send for somebody with tools to come and get out the stub, which is not always a pleasant matter in the face of an unjust employer. How often has the writer seen a steam-chest cover or even a cylinder head put on with one nut short, or a governor fastened on with three bolts, when there is a place for four.

The *Sanitary Engineer* makes a plea for architectural decency in wind-mill towers. It very truly says: "There is no need, that these useful appliances should be as ugly as in most cases they are. On the contrary, they might be made exceedingly picturesque and add to the interest of the landscape, instead of marring its beauty, and this at very slight additional cost.

A Dangerous Mud-drum.

Regarding the recent destructive explosion of a mud-drum, in one of our large cities, *The Locomotive* gives a description, and comments as follows:

"The boilers, of the flue type, were in a battery of four; each forty-two inches in diameter and twenty-four feet long. Natural gas was the fuel used. The steam-drum and connections were above the boilers, and the mud-drum connections to the bottom of the boilers, were made as they commonly are where this form of boiler is used; and as such details appear to be of secondary importance in this case, the foregoing brief description is thought to be sufficient.

"In connection with these boilers, there was an open heater, into which two of the mill engines exhausted. The feed-water, after passing through this heater, was pumped into one of the outside boilers, through a patent feed-water heater, largely used in that locality, which may be described as a pipe placed in the boiler above the water line, so that the feed traverses a considerable distance, exposed to the temperature of the interior of the boiler, before it is discharged.

"In this case, the feed attachment was upon the top of the boiler, upon the second course of shell plates; and the connecting-pipe extended nearly to the front-head; then, curving by an elbow, it returned to the back end, dropped down between the flues of the boiler, and discharged through an open-ended, two-inch pipe, at the mouth of the lower neck-connection to the mud-drum, a distance of some forty-five feet from its place of entrance. When this drum exploded under a steam pressure of 100 pounds, it was found that a portion of the plate upon the bottom part of the drum, immediately beneath the outlet of the feed discharge-pipe, and over the stand, had wasted away from its former thickness of one-quarter of an inch, to less than one-sixteenth of an inch. This thinning covered an area of about one hundred square inches; but the dangerously thin part immediately beneath the feed discharge, was of much smaller dimensions. As this part rested upon the stand, it was difficult to detect it by a hammer test; and it is very doubtful if a hydrostatic test would have revealed it either (?), for the stand beneath would have reinforced and prevented the buckling of the weak part of the plate.

"The explosion was probably caused by the fracture of this thin plate, in a longitudinal direction. This stripped off a piece of the lower part of the drum, which straightened out, and turned up on each side. The effect of the escaping contents of the drum and boilers, through the opening thus provided, would be to raise the boilers off their supports. The end of the drum being bricked in the wall, momentarily resisted this movement; but the end of the drum was torn off nearly on line with the wall.

"An examination of the unruptured portion of the mud-drum, immediately after the explosion, showed considerable internal pitting and corrosion of the shell and heads, through not enough to weaken the structure, while the external surface was free from leaks or defects, and the glazed finish of the plates was scarcely disturbed.

"An examination failed to show the presence of grease or other substance which might account for such a remarkable waste of plate.

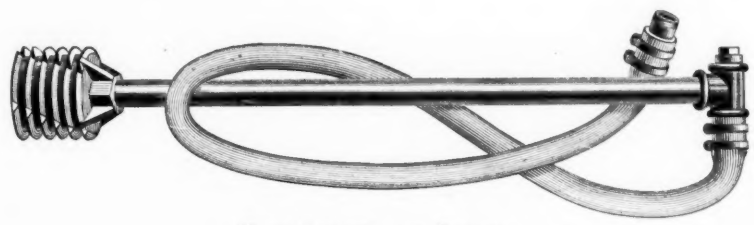
"There was a sight-feed lubricator upon each of the two engines, which would prevent a wasteful quantity of oil; and there was no probable cause for believing that oil had anything to do with the trouble in this case, though it is a cause of much trouble in many other cases.

"It had often been found that a feed, discharging against the plates of a boiler, had occasioned a wasting of the plates. This would probably vary in intensity according to the character of the water and temperature of the feed. If fine sand or dirt were present, it would cut the surface of the plates acted upon still more rapidly, and after the skin of the iron had been penetrated, the work of destruction might be expected to proceed with great rapidity. But we should not look for sand or dirt in sufficient quantity to be harmful in the city water, with which these boilers were supplied; and the fact that the previous drum had lasted over seven years, under precisely the same conditions, as we were informed, and that many other boilers in the same locality use the same feed attachment, would seem to justify the belief that this arrangement of feed, though objectionable, is not always dangerous, unless combined with the other destructive elements.

"The dangerous weakening in the same boiler, or some parts of a plate, by pitting and corrosion, while other parts or the adjacent plates are untouched, is plausibly explained as due to stuctural differences in the plate, and may have been an important factor in this case.

"The facts upon which the foregoing is based, were developed at the coroner's inquest. The jury selected by the coroner to hear this case were of more than average intelligence, two of their number being practical engineers. The investigation was patiently conducted with an evident desire to learn all the facts, and extended over a period of nearly three weeks. Their verdict attributed the explosion to the rupture of the mud-drum, and censured the county inspector, the deputy county inspector and the chief engineer of the mill, for not detecting the corrosion which caused the explosion.

"Before closing this article it may not be amiss to say a few words about mud-drums, although we have written and said so much on this subject at different times, that much of it may be a repetition. Readers will bear testimony to the fact that we have little faith in mud-drums, for that useless appendage (as we deem it) does not accomplish the purpose for which it is used, while it is a source of danger and expense, and whatever need may have existed for such an attachment when it was first introduced, can be accomplished, so far as stationary boilers are concerned, in a safer, cheaper and better way to-day, by other means.



FLUE CLEANER AND SCRAPER.

"But we are well aware that in some parts of the country, a steam boiler without a mud-drum attached is considered incomplete, and is regarded with little favor. To those who hold this belief, we would suggest that the use of such drums may be made safer by attaching them in such a way as to permit a thorough examination at all times.

"Boilers with mud-drums should be supported by hangers or wall-brackets, according to circumstances, and never by stands beneath the drum; and the blow-off should be in the bottom of the drum, at its lowest point, so that it may be effectually drained through the blow-off pipe. The feed should not enter the mud-drum. It is much safer and better to introduce it on top of the boiler, or at the water-line, through the front or back heads. But in any case this work should be done under the supervision of an inspector, who will make suitable provision for running the pipes properly, and discharging the feed at the safest place.

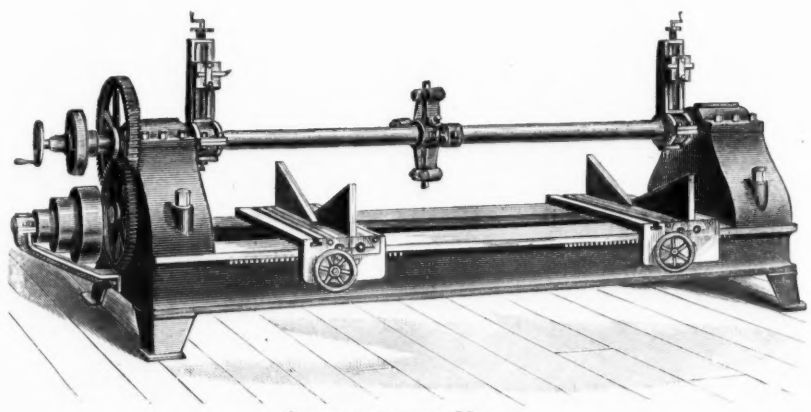
"Our inspectors condemn a large number of mud-drums every year. We have sometimes felt that our assured regarded us as being too critical in this matter. But we knew that we were right. Some remarkable experiences have been related to us by steam users, of mud-drums that they had sometimes used until decayed to a mere shell. We regarded such an experience as being particularly unfortunate for them, if it afterwards caused them to take dangerous risks — risks that might end in an appalling disaster."

The experiment of freezing, by means of refrigerating machinery, the surface of a tunnel, consisting of light, wet gravel, mixed with sand, has been successfully accomplished, says *Engineering*, in a tunnel at Stockholm. The gravel and sand were not wet enough to run, but sufficient to cause great anxiety in regard to the foundations of structures above the tunnel, which have been successfully passed since the use of the freezing device commenced.

Man and Horse Power.

In a recent letter to the *Milling World*, Olin Scott says:

A fact not known to many persons who are accustomed to working horses on wagons and other vehicles in hauling heavy loads, is that the power of a horse exerted horizontally in drawing a load is but two hundred pounds, and if the horse moves ten rods per minute he does the work equivalent to the standard horse-power; and a man averages one-eleventh as much as a horse. These figures are taken at what the horse or man can do on an average, day after day. An average man lying horizontally on a ladder placed at a height above the ground, so as to be level with the traces of a horse's harness, can place his feet against one rung of the ladder, and, extending his arms, grasp another rung with his hands, and, having a harness over his shoulders, can defy the average horse to draw him off the ladder. I have seen an athletic man so placed on a horizontal ladder challenge any two horses to draw him from his position, and no doubt many of your readers have seen the same thing. Very few horses pulling horizontally are able to raise a three hundred pound weight. A "man-power"—*i. e.*, 3,000 pounds hoisted one foot per minute"—is about equal to hoisting eighty barrels of flour ten feet high per hour.



CYLINDER-BORING MACHINE.

"Now, sir," said the prosecuting attorney, pompously, "you are a railroad man, you say. Now, sir, let's see how much you know about your business, sir. What motive, sir, has your company for running its trains in the city faster than the ordinances decree?"

"What motive?"

"Yes, sir; What motive? Come, sir!"

"Why, locomotive."

The witness was fined for contempt of court.—*National Standard.*

Hearing Through the Teeth.

The passage of steam into either end of a cylinder may be very distinctly heard by putting a rule, a piece of wood or a piece of iron between the teeth, stopping the ears with the fingers, and putting the free end of the piece of wood or iron against the cylinder. Both ends of the cylinder may be "heard" in turn; both pillow blocks may be tested in the same manner for lost motion, and the steam-chest may be tried for end motion in the valve connection. A great deal is to be learned by "hearing through the teeth"—try it.

Beware of long, crooked suction pipes, when erecting a pump. Bends, returns and angles increase friction very rapidly. Also remember that doubling the diameter of a pipe increases its capacity four times.

We find the above paragraph in the *Scientific American* of January 9, 1886, to which we will only add: Beware of the practice of copying editorial paragraphs without giving credit, and remember that the one here referred to first appeared in the AMERICAN MACHINIST of December 19, 1885.

Vanduzen's Boiler Flue and Tube Cleaner.

By the peculiar construction of this device the full force of the steam is projected upon the inner surface of the flue, forcing the soot and ashes back into the ash and combustion chamber.

The device is also a flue scraper, having from five to seven annular rings with sharp angular edges cast upon its outer surface; these annular rings are made the proper diameter so as to pass into and through the flue; the sharp angular edges acting as so many scrapers upon its inside surface, thus forming a steam flue cleaner and a flue scraper combined in one. The valve and cleaner are connected by a short section of four-ply steam hose of the proper size.

Before opening the globe valve, the cleaner head is laid so the water from the condensed steam will be blown into the ash pit; the steam is blown through the pipe, hose, and cleaner about ten seconds to warm them up, then the cleaner is held in the end of each flue three to five seconds, or it can be pushed any distance into each flue at the will of the operator. By having an extra piece of gas pipe for a handle, the cleaner can be used as a scraper, either with or without the steam attachment being connected.

The manufacturer is E. W. Vanduzen, 104 East Second street, Cincinnati, Ohio.

Cylinder-boring Machine.

The L. B. Flanders Machine Works, (Pedrick & Ayer), Philadelphia, have lately designed and are putting on the market the cylinder-boring machine, which we illustrate on this page. The machine is intended for new work, and will bore from 8″ to 22″ cylinders, facing off the ends and boring at the same time.

The flanges are turned afterwards, as the saddle that the cylinder is fastened to, has a movement of several inches either way (a bent tool is placed in the facing head, and the cylinder is moved). The V's that hold the cylinder, are each independent and adjustable, allowing any shaped cylinder to be quickly brought central. The clamping device is one of the principal features of this tool. A detachable link chain, that can be lengthened or shortened, holds the cylinder, allowing very little opportunity for springing. By loosening one collar screw, the bar can be pulled clear of the cylinder and shoved into its place after the cylinder is placed on the V's. The feed casing on the end of the bar, contains gearing that admits of several changes of speed, to suit the work. This gearing is driven by a four-step cone pulley. The head or bar support, on the opposite end of the driving gear, slides on the shears to accommodate different lengths of cylinders. The machine is strong, neat and powerful and will be found useful in railroad shops and by steam-engine builders.

Making a Defective Patent Valid.

A patent, or what purported to be a patent, No. 236,052, on payment of the final fee, was issued December 28, 1880, to Elon A. Marsh and Minard Lafever, of the machinery firm of Marsh & Lafever, Battle Creek, Mich., covering improvments in steam-engine valve gear, which have since been considered of great value. Subsequently it was discovered, in the course of certain litigation, that letters patent, No. 236,052, by an accidental omission, had never been signed by the Secretary of the Interior, as prescribed by law. Meantime a new Secretary had come into office, who found himself powerless to rectify what was so obviously an accidental omission, and Messrs. Marsh & Lafever had no remedy except an appeal to Congress. Senate Bill No. 500 and House Bill No. 1,779, are bills to declare their patent valid. These bills are in accord with simple justice, and we hope they will be promptly passed.

Pumping Melted Lead.

An English mechanical paper speaks of a steam pump for pumping melted lead, which is in practical operation in Germany. Although the principle is not new, the application is novel, as will be seen by the following description from *Engineering:* "The steam pipe has on it a three-way cock, which is now connected to the pipe from the boiler. The cock being first turned so that the pump cylinder communicates with the air, the lead outside raises the ball valve and fills the cylinder. The cock is then turned so that the communication with the air is closed, and steam of suitable pressure is let in. This at once closes the ball valve, and forces the lead to rise in the delivery pipe. In this way the cylinder is emptied, and as soon as the lower end of the delivery pipe is free from lead, the steam rushes up it, thus lowering the pressure in the cylinder so far that the lead can again open the ball valve and rise in the cylinder. The steam pressure then again rises, closes the ball valve, and expels the lead as before up the delivery pipe. These alternations follow one another very rapidly, and an almost continuous stream of lead is ejected from the pump, so long as enough remains in the pot to open the valve and rise in the cylinder."

LETTERS FROM PRACTICAL MEN.

Another Key-fitting Tool.

Editor American Machinist:

In the AMERICAN MACHINIST of January 16, W. H. Chappell gave some ideas in regard to fitting keys, and also describes an instrument to facilitate getting the correct taper. The instrument mentioned, calls to mind a handy little rig that an apprentice, M. P. Armstrong, made in a shop where I worked some time since. It was only a make-shift to be sure, but answered its purpose admirably and never failed.

It consisted simply of two pieces of tin, about 8″ long, by $\frac{1}{2}$″ wide, riveted together at each end, but not so closely as to prevent a third piece from being placed between the other two and made with suitable notches near its ends to allow the rivets of the side pieces to pass through, and the third piece to be easily moved so as to diminish the width of the rig by its insertion into the key-way.

In operation, if it is sufficiently opened to more than fill the key-way, no regard to even an approximate taper being required, the rig is inserted into the key-way as far as it is desired to have the key enter, when it may be withdrawn, and used as a pattern template for the correct taper.

With key-ways which are swelled at the mouth, caused by planing with a long, springy tool, or hard iron, or both, I should think Mr. Chappell's plan might require a variable factor to be used as a minus quantity when laying out the key.

Will some one who has been there, tell us, through your department of "Letters from Practical Men," how to successfully prevent the crowding off which occurs when cutting slots in brass with a milling saw?

Our trouble is in cutting a slot about $\frac{1}{8}$″ in width, $\frac{3}{8}$″ deep, and leaving a piece of $\frac{5}{64}$″ thick, standing between the cuts. Even though we have pieces closely fitting as many as five cuts next where the cutter is at work, still the crowding continues. It seems to arise from a sort of burnishing action of the chips or cutter. The cutter is quite sharp and shows plenty of side clearance, and I am uncertain what is the cause of the trouble.

CHARLES S. BEACH.

Bennington, Vt.

Hammer Dies Again.

Editor American Machinist:

The method of moulding hammer-dies by George O. Vair, in the AMERICAN MACHINIST, January 16th, is a decided improvement on the plan shown by the writer, in issue of August 29th, '85.

It is understood that hammer die patterns made in several pieces, as in the articles referred to, are to be made that way only when their face is so shaped (to perform the work for which they are designed) as to prevent their being moulded as in the cut herein illustrated.

We have lately made a number of dies with from one to three plain half circles of different size in the face of them, the pattern being made in two pieces.

A is a cope piece, *B* the drag, with a riser at *C;* we use a skim gate to pour these, and when they have been properly moulded we have had no trouble in making dies with a clean face that fit without finishing.

We have also made a number of plain hammer dies, the pattern being in one solid piece, moulded on end in the drag; these we gated at *D*, and had a riser at *E* to feed them up.

ROBERT E. MASTERS.

Rattling in Blast-furnace Heater.

Editor American Machinist:

Some time since the rolling-mill machinist's attention was called to a heater, through which the feed-water passed from the tank to the boiler feed-pumps. It was known to be leaking some, and kept up a continued rattling noise. The pipes had been renewed but a short time before by the machinist, who had just quit; the workmanship was unquestionable.

The heater was about 30″ diameter by 7 feet high, and stood upright, a 2″ pipe passing in at the top, up and down several times, and out at the bottom, thence about 10 feet to the pump. The pipe was exposed to the steam from one blowing engine and two tank pumps, which exhausted into the heater.

The cap of the heater was removed, and the pipes were found to be loose at nearly all points and laying about in all possible directions. They were replaced by new ones, carefully fitted up, the pumps started again and the noise was unchanged. It had been believed to be caused principally by the exhaust bumping the pipes together before, as it was impossible to support them rigidly, but that could not well be so now. A small air chamber was placed between the pump and heater, overcoming the reaction to the water caused by the pump's valves closing against the tank elevation. Since then the heater has been quiet, and the pump works better.

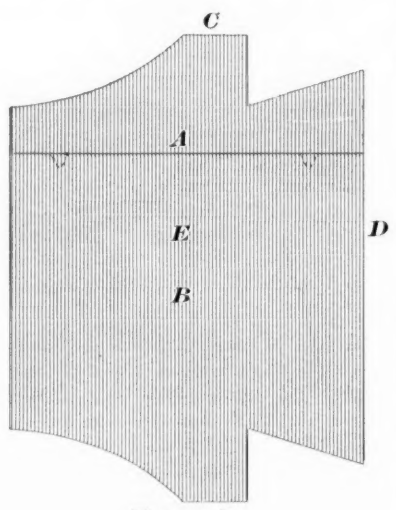
H. B. W.

Milling Machine Dog for Taper Work' and for Lathe Work.

Editor American Machinist:

In your issue of April 18, 1885 on the subject of milling taper work, I notice a complication of dogs which are considered by the writer to the truly universal. I do not desire in this to present the numerous objections which I would have against the use of such a dog, and will agree with the writer in his objection against the necessity for using such dogs. I desire, however, to illustrate to your readers a common dog, which we have in every-day use, which answers all the purposes of a truly universal dog as nearly as such a thing can be attained without complication in either the dog or milling-machine attachments.

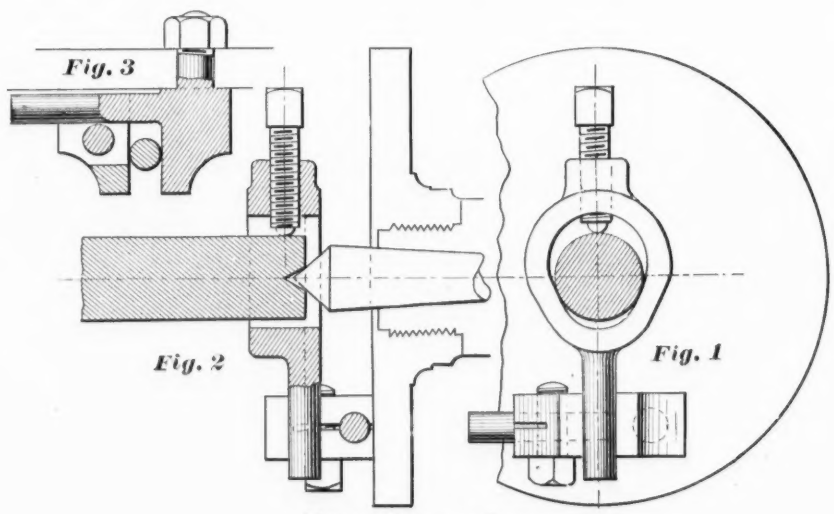
Fig. 1 represents a dog with its tail turned round in a true central line, with the set-screw and lineal center of the dog.



HAMMER DIE.

Fig. 2 represents a side view in which it will be observed that the tail is turned flush with one side. This is done in order to have sufficient stock left for clamping when the dog is fastened to the work, throwing the center of this round tail in a line with the center of the work, as seen in dotted lines.

This round tail is held in an adjustable clamp, attached to the face plate, not sufficiently tight to bind, but close enough to prevent all shake backward or forward. This tail, figuratively speaking, now rests in a perfect fitting slot, Fig. 3, which admits it to slide forward and backward; also to revolve without play and without any strain on the work whatever.



MILLING MACHINE DOG.

A dog of this style, if correctly made and properly adjusted on the work, answers all the purposes for milling or indexing taper work as is usually required. Our experience is that a dog of this style is easily made and answers not only for milling, but for lathe work also, especially for chasing screws and taps. It prevents all play backward or forward, enabling the operator to reverse his lathe either way without the danger of the tool riding on the thread as is often the case with a carrier pin and dog, when there is no provision for taking up the back-lash. There is no patent on this dog.

FRED. HOLTZ,
Supt. Cincinnati Screw and Tap Co.

Inside Micrometer.

Editor American Machinist:

The sketch on opposite page shows the construction of what I have found to be a very convenient tool. I have concluded to contribute it for the benefit of the craft. In the sectional view of the frame of the tool, is a taper-tapped hole *j*, into which a handle, not shown, may be immovably secured for convenience in manipulating the tool; *b* is the measuring screw, working through one end of frame, which is tapped and split in the usual way for taking up any wear of nut or screw; *c* is the index sleeve, which is provided with a raised milled band to aid in turning with thumb and finger. This sleeve fits closely in the gap in frame, but freely enough to revolve easily; *d* is a taper bush fitted to index sleeve *c*, and split through one side for the insertion of the feather *e*. The taper bush, with feather inserted, is driven into index sleeve and held by friction. Measuring screw *b* is splined to fit feather *e*, and the operation of the tool is obvious.

Both ends of index sleeve are graduated, and zero marks coincide simultaneously with marks on the flanges of the frame. These flanges extend beyond index for the purpose of preserving the adjustment of the same when the tool is laid down. A hollow hardened bush, *f*, is screwed into the lower end of frame *a*, and performs the double purpose of centering the index and forming a shoulder, against which are screwed the different lengths of *positive* measuring pieces, as *i*. These pieces have permanent levers (or wrenches) attached, as *g*, for insuring a close contact against the shoulder. An adjustable hardened tip, *i*, is designed to compensate for wear in use. A lengthening piece, *l*, is employed to save extending the series of measuring pieces unnecessarily for large diameters. Each piece is stamped with the number corresponding to the *smallest* diameter measured with such piece in place, or when the measuring screw is down at starting point and index on zero mark.

The measuring screw *b* is provided with a series of rectilinear grooves *x*, which are formed by the taking out of a certain number of threads longitudinally with the screw. Say the threads on the screw are 32 to the inch, then by leaving the first thread and cutting out the three following ones, leaving the *fifth* intact, and taking out the next three, and so on, each of these spaces, from *point* to *point* of thread over the groove *x*, becomes the exact measurement of an eighth of an inch.

The end, *k*, of the frame is provided with a *spiral incline* corresponding to the pitch of the thread on measuring screw *b*, so that, beginning with the line of the split for binding screw, the point of a thread will follow the incline until a complete revolution is made and the next thread appears. The size is read by the graduations on the screw, counting from the spiral, and the divisions on the index, counting from zero. These readings are added to number stamped on the measuring piece in place at the time.

Watertown, N. Y. O. S. WALKER.

Water Motors.

ABSTRACT OF A PAPER READ BEFORE THE BRITISH INSTITUTION OF CIVIL ENGINEERS. FROM VAN NOSTRAND'S ENGINEERING MAGAZINE.

BY W. C. UNWIN, B. SC.

Water motors are not now, or in this country, so important as heat motors, and there is even possibly, among many engineers, an impression that water motors are at best rather feeble machines, suitable only for small industries. And the importance of water-power even in this country, might be greatly increased. In some period there must begin to be felt the pressure due to the limitation of the coal supply. No great increase of the price of coal is needed to make water-power much more valuable than it is at present. On the other hand, if the electrical engineer will make the transmission of energy easier, the importance of water-power would increase, for one of its greatest defects is that it exists in the localities where nature has placed it, and not in the places where it can be most conveniently used.

Numerous isolated cases of the transmission of energy electrically, to do mechanical work at a distance, are in successful operation, but most of these cases have been more or less experimental, and the cost has not been greatly regarded. But one case, in which the electrical transmission of water-power has been successfully carried out on a strictly commercial basis, has come under my notice.

I.—Bucket or Cell Wheels. First, bucket or cell wheels, in which the water fills the buckets near the top of the fall and descends in contact with the wheel without acceleration.

About this class of motors I have time to say very little. They are simple in principle, and have a fairly high efficiency. But they are somewhat cumbrous and antiquated machines. On falls above 70 feet they cannot be used. On falls of 20 to 60 feet a turbine is cheaper, and yields an equal efficiency. On a low fall, if a turbine costs as much, it has, if well constructed, a higher efficiency. Still in one respect a good overshot or high-breast wheel is superior to most more modern water motors. Its efficiency is nearly the same with a reduced supply of water as with the full supply. In this respect many turbines, otherwise excellent, compare very unfavorably with the water wheel.

II. Pressure Engines.—The second way of utilizing water-power is to bring the water to the level of discharge in a closed pipe at small velocity, but with a pressure but little less than that due to the height of fall. The water under pressure acts on the piston of a pressure-engine, as steam acts in a steam-engine.

Although a water-pressure engine is, in certain cases, a perfectly successful and economical machine, it is not, in most cases, the best plan to utilize water-power in this way.

The great difference between steam under pressure and water under pressure is—that one is a comparatively light fluid indefinitely expansible, the other a comparatively heavy fluid, the volume of which is not measurably changed by any ordinary variation of pressure.

The frictional losses of energy in a fluid are proportional to its weight. If, for instance, water is 500 times heavier than steam, then at the same velocities of flow the frictional losses are 500 times greater in the water than in the steam. To prevent enormous waste of energy in friction, a water-pressure engine must be run much more slowly than a steam-engine, and all the pipes and passages for a given volume of flow must be much larger. A steam-engine has a piston speed of 400 or 500 feet per minute; a water-pressure engine rarely has a speed exceeding 80 feet per minute. Steam flows in steam-pipes with a velocity of 100 feet per second, but in the passages of a pressure-engine the velocity of the water does not exceed 4 to 6 feet per second. It is when an exceptionally high pressure can be obtained, or requires to be used, that the water-pressure engine is most applicable.

The second difficulty in the use of water in a pressure engine arises out of its incompressibility. In such engines the inertia of the fluid behind the piston tends to produce an acceleration of velocity and shock at the end of the stroke, which, in general, can only be prevented by means which reduce the efficiency of the engine.

III. Turbines.—There are motors, of which the under-shot wheel is an old type and the turbine a modern type, in which the head is allowed to take the third form before acting on the motor. On undershot wheels and turbines the water acts in virtue of its velocity. Let the water acquire a velocity due to the head in a given direction. Then the water, by its inertia, opposes change of velocity and direction. In the class of wheels now discussed, the water gives up its energy through this action of its inertia.

Of the whole energy expended by the water on the machine, a part is taken up and utilized, another part is wasted or lost. It is the object of the designer to make the latter part as small as possible, and it is therefore necessary to consider in what ways this loss or waste of energy may arise.

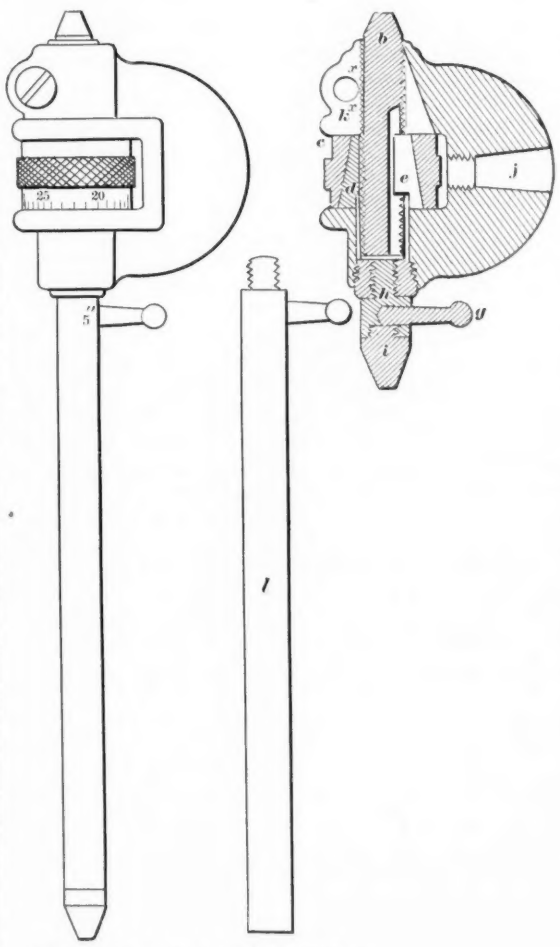
1st. There is a waste of energy if the water is allowed to break up into eddies or irregular motions. When water breaks up in this way we say there is loss by shock.

2d. The water leaving the machine may carry off with it part of its energy, there is then a waste of unutilized energy. In many motors this loss is a large one. In the class of motors now considered, this energy rejected can be made as small an amount as we please.

3d. In flowing over the solid surfaces of the machine there is what is termed fluid or skin friction. This is really a loss of the same kind as that due to shock, because skin friction arises from the production of small eddies against the roughnesses of the solid surfaces, or from instability in the fluid itself.

Losses due to shock or breaking up.—If water is poured from a height into a basin, it acquires, in falling, energy of motion. Reaching the vessel, it is dashed about in different directions and broken up into eddying masses. In a short time the friction destroys this irregular motion, and the energy is wasted.

Let the water be moving along a pipe which changes section abruptly. Then the velocity in the first part is changed in the second. At the abrupt change of section, eddies are continually formed, which carry off part of the energy of the fluid in a useless form. For example, if the section of the pipe is doubled,



Walker's Inside Micrometer

the loss of energy is one-fourth; if the surface is curved throughout, there is no loss due to breaking-up, and the water flows round with its velocity unchanged, except so far as there may be a very small loss, due to the friction of the surface.

Hence the second condition for avoiding loss in dealing with streams of water is, that the surfaces over which it flows should be gradually and regularly curved.

Generally in hydraulic motors we have to deal with fixed jets of water impinging on moving curved vanes. The condition of avoiding loss due to abrupt change of direction imposes a third very important condition as to the direction of the vane where the jet first impinges.

These three conditions can always be satisfied, and hence there need be no loss in an hydraulic motor, due to the shock or breaking up of the fluid.

The two other sources of loss in an hydraulic motor, the energy carried away, and the skin friction against the surfaces of the motor are not so easily disposed of. We can, indeed, reduce the energy carried away almost as much as we please. If there were no skin friction, turbines might have any efficiency short of 100 per cent. The energy carried away in good turbines is often not more than six per cent. But it might be reduced to three per cent. or one per cent.

About twenty years ago there was introduced, a form of impact wheel, which, with American talent for nicknames, was called the Hurdy-Gurdy. It consisted of a wheel of considerable diameter, with a series of cast-iron floats, four to six inches wide on the face. A jet of water of very small diameter (three-eighths of an inch sometimes) was allowed to strike the vanes normally. Theory shows that in this case the wheel should run at half the speed of the jet, and that the efficiency, even apart from friction, could not exceed 50 per cent. Practical experience also showed that the wheel should have half the velocity of the jet, and the efficiency was found, by experiment, to be 40 per cent. In spite of the low efficiency, such wheels seem to have been useful, partly, because they were cheap and free from liability to accident, but mainly, probably, because by choice of diameter of wheel, any convenient speed of rotation can be obtained. It is easy to see that the efficiency could be improved by substituting cups for flat floats, and this is what has actually been done. The favorite wheel now is a wheel termed the Pelton wheel, the floats of which are simply cups which deviate the water backwards.

The Jet Reaction Wheel or Scotch Turbine.—There is a very simple form of reaction wheel, which forms a convenient step towards a true turbine. In this the water enters the center of the wheel, spreads radially, and issues in jets tangentially to the direction of revolution. The water issues under the head due to the fall and due to the centrifugal force of the mass of water in the wheel.

Taking friction into account, the best speed of the wheel is the velocity due to the head, and then about 17 per cent. of the energy is carried away, and another 10 or 15 per cent. is lost in friction.

The Scotch turbine would, from its simplicity, be still used in certain cases, but that it is the most unstable in speed of all turbines, and it admits of no efficient mode of regulation for a variation of water-supply.

All these turbines are pressure turbines—that is, turbines in which the water enters the wheel under pressure.

To maintain this pressure properly two conditions are necessary—the wheel passages must be completely filled with the stream of entering water, and consequently the wheel must receive the water continuously over the whole circumference simultaneously. These are therefore turbines with complete admission.

M. Girard constructed turbines in which the water issued from the guide-blades with the full velocity due to the fall, and therefore with no pressure. The wheel must be placed entirely out of the tail water. Nearly the whole energy of motion of the water, less the loss in friction, is given up to the wheel. Turbines of this kind are called turbines of free deviation or impulse turbines.

Impulse turbines may be inward, outward, or parallel flow turbines, but they are very commonly outward flow. For normal conditions of working they are slightly less satisfactory than pressure turbines, but they have two very great practical advantages.

In a pressure turbine there must be a definite rate of flow through the wheel to maintain the exact distribution of pressure in the wheel for which it is calculated. If the guide-blade passages are partially closed, the distribution of the hydraulic pressure is completely altered, and the efficiency reduced. In the turbines of free deviation, on the other hand, there is no possible change of pressure in the wheel, for it is all open to the air. Each particle of water following the curve of the wheel-vane acts by itself alone without any interference from its neighbors. Hence, if the guide passages are partially closed, the stream on the wheel is rendered thinner, but its efficiency is in no way impaired. Hence the regulation of the Girard turbine is in general far more perfect than in a pressure turbine.

The worst mode of regulation of all, though it is still frequently used, is to put a throttle valve in the supply pipe. A throttle valve acts entirely by creating a prejudicial resistance, or by destroying part of the effective head.

Next worst to this, perhaps, is the form of sluice adopted in the Fourneyron turbine, a circular cylinder which slides in the clearance space. It is obvious that, when the stream entering the wheel is narrower than the width of the wheel, there must be a general breaking up of the stream, and a complete alteration of the conditions of pressure and velocity for which the wheel curves are designed.

The curves for the Hercules and Humphrey turbine show results, I believe, as good as any reliable results obtained in America, the latter being, perhaps, the most reliable.

The sluice arrangements in American turbines do not seem, from the theoretical point of view, particularly good; but although American makers do not explain the principles on which they proceed, I suspect that in these turbines some approach is made toward the condition of free deviation, in which case the defects of the sluice produce a less unfavorable effect.

For pressure turbines, only one approximately perfect mode of regulation has ever been adopted, and that is the movable guide-blades of Professor James Thomson. With this arrangement the water enters the wheel over its whole circumference and depth, with its velocity and direction little changed, in all positions of the guide-blades. The only objection to this mode of regulation is that it involves a certain amount of mechanical complication.

For Girard turbines with partial admission, the mode of regulation is simple, and perfectly complies with theoretical conditions; the width of the stream entering the wheel is altered without in any way affecting the perfect action of the water in the wheel.

The forty-sixth meeting of the American Institute of Mining Engineers will be held at Pittsburgh, Pa., February 16, 1886.

At the recent annual meeting of the Engineers' Club of Philadelphia, Washington Jones was elected president, and Howard Murphy was re-elected secretary and treasurer. It is proposed that the club shall make water supply, sewerage and municipal engineering a leading topic in the future.

In the trial of a recent patent case in England, in which the validity of the Otto gas-engine patent was attacked, the presiding judge said that he construed the meaning of the specification to be, not that there was an absolutely incombustible body of gas, or cushion, between the piston-head and the explosive part of the charge, but that the combustible particles were more or less dispersed throughout the whole charge, the mixture being stronger near the place of ignition; also, not that the actual pressure in the cylinder was increased as the charge burned gradually, but that the decrease of pressure, as the gas expanded, was lessened by the continual combustion, and development of heat. Among the experiments referred to were those of Professor Dewar. He had tapped the cylinder at three points, and had found that the gas existed at those points of the relative richness of 10, 7, and 5 per cent., just what would have been expected from the specification. In conclusion the judge said that he came to the conclusion on the whole case that in Dr. Otto's engines there was, at the time of ignition, a mixture heterogeneous and not homogeneous; that it had exactly the effect which Dr. Otto said it had in the first claim, that there was no anticipation, and that the patent was valid and good.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.

JACKSON BAILEY, Vice-Pres't.

LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, Mechanical Engineer.

The American News Company,

Publishers' Agents, New York.

The International News Company,

11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

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CONTENTS.

	PAGE
Novel Steam-engine Details	1
Pattern-making. By F. W. Barrows	1
Ventilating an Engine Room—Uncovered Steam Pipes—Hot Feed Water—Grinding a Pump Plunger. By James F. Hobart	2
Crystallization or Granulation? By S. W. Goodyear	2, 3
Root's New Acme Hand Blower	3
Graphite. By John A. Walker	3
San Francisco Experience in Running Cable Roads	3
A Convenient Angle Plate. By A. B. Landis	4
Comparative Density of Solid and Melted Cast Iron	4
An Examination in Steam Engineering	4
A Dangerous Mud-drum	5
Man and Horse Power	5
Vanduzen's Flue Cleaner and Scraper	5
Cylinder-boring Machine	5
Hearing Through the Teeth	5
Making a Defective Patent Valid	6
Pumping Melted Lead	6
Letters from Practical Men—Another Key-fitting Tool. By Chas. E. Beach—Hammer Dies Again. By Robert M. Masters—Rattling in Blast-furnace Heater—Milling-machine Dog for Taper and Lathe Work. By Fred. Holtz—Inside Micrometer. By O. S. Walker	6
Water Motors. By W. C. Unwin	6, 7
Begin With the New Year	8
Invention and Re-invention	8
Mechanics' Institutes and Evening Schools	8
Offensive and Defensive Preparations	8
Boiler Tests	8
Questions and Answers	9
Manufactures	9
Machinists' Supplies and Iron	10

Begin With the New Year.

In the letters from machinery establishments, published in our last two issues, regarding the state of trade, and continued this week in our "Manufactures" columns, may be found several useful hints.

One steam-engine establishment reports, as a gratifying feature of the past year's business, that their total "bad debt" account amounted to less than two-tenths of one per cent. of their sales. Devising plans for keeping this account within bounds, may well engage the thoughts of other machinery concerns just at this season. Some may have been confining their sales to too small a territory, and so have been forced to take needless risks, in order to increase the volume of business. Others may have erred in the opposite direction, and spread out over too wide an area, with like result.

Another shop began last year about this time to make preparations, in the way of new tools and improved methods, for the increased business which they "felt sure was coming." Note the advantage of thus preparing in advance. When business does revive, whether their expectations as to time are correct or not, the concern is not forced to spend time in making belated improvements, which could have been better done during a season of less activity, and with less hindrance to profitable business. No better season can be found for looking the shop over, with this end in view, than the present.

Doubtless, too, many establishments could profitably use the new-year season in revising their inventory methods. Valuations of tools, patterns and fixtures, which lapse of time and changes in the currents of trade have rendered incorrect, because inflated, and injurious, because misleading, may be revised, just at this season, to specially good advantage. Such valuations, where greatly defective, can hardly fail to be reflected in errors of policy and methods. Careful attention each year to this subject is, of course, better than letting it drift until the need of radical treatment becomes apparent.

The present, too, is a good season to revise prices, because it is a season when others will be likely to be similarly occupied. One of the letters which we publish this week says, in substance, of the machine-tool trade: "The buyer has the advantage now; the seller may have shortly."

Where a machine tool has been closely held by the aid of patents, or other circumstances giving it substantial control of the market, the new-year season may wisely be selected as a fitting time for such reduction in price, as improved methods of manufacture may abundantly compensate for, and such as will be likely to lead to its greatly extended use. But in the general line of machinery, which has been sold during the past year on too small a margin of profit, other establishments will do well to adopt the policy, outlined in another letter, of marking prices, wherever they will bear it, a little higher, rather than a little lower, as has hitherto been the tendency. The more generally the experiment is tried, the more likely it is to be successful.

In many establishments, too, this is the catalogue and circular season, and no better time than early in the year could be chosen for the work of eliminating the extravagant claims and depreciatory remarks, as to competing products, which disfigure some such publications. Not seldom do the writers of such circulars omit the information as to details of construction and operation, which are worth more than all the remainder of the document, to the mechanic, who, from the nature of his position, is perhaps obliged to become virtually responsible for the selection and use of the machine referred to.

To shopmen, as well as to shops, the year, though in harness and working, is still the new year, for all the purposes of improvement. In making desirable changes, whether of thought or action, it is often helpful to have a stimulus from without. Such is the present time of retrospect and outlook. Why not begin with the new year?

Invention and Re-invention.

The American people are an inventive people. Every week brings a report of four or five hundred patents granted during that time, and of the rejected and unpatented "inventions," we may only form an estimate.

There are thousands of so-called "inventions" which have been invented and re-invented, time after time, by different people. Each person is sincere in his belief that he has hit upon something of value to the world, and he spends his time and money freely to secure the device by letters patent, and often finds that he has been following in the footsteps of a man who invented precisely the same thing, five, ten, or even twenty years before.

When a man becomes interested in a particular operation, or branch of mechanics, or in perfecting a certain tool, process or idea, he always discovers things which are new to him, and which he too often regards as new to everybody else.

As a case in point, a man "invents" an improved cut-off valve for a steam-engine. Before spending much time upon the device, he wisely reads up what others have done in that line, or consults some person of authority, who says:

"Mr. ——, worked out that theory in 187—. He found it of no practical value because of this and that defect, for which he could find no remedy."

In this case the "inventor" is "let down" easily; his time and money are saved, and he can either drop the project altogether, or confine himself to the known defects or, in fact, receive the benefit of the study which had been given the subject by others, and thus secure an advantage which would otherwise be impossible by beginning where they left off.

Why then should not the inventor look up previous labors in relation to his particular study? He should do so, and it must be done eventually, therefore let it be done *first*, and not consume energy in beating a new ground which has been thoroughly covered, and all its resources fully developed.

Mechanics' Institutes and Evening Schools.

Another step in the right direction has lately been taken in Rochester, N. Y., by the establishment of an institution for the education of working people. It is called "The Mechanics' Institute;" Henry Lomb, president; E. C. Colby, formerly of Lawrence, Mass., instructor in drawing.

A fund has been collected by subscription, which will be applied to the maintenance of classes in drawing, mathematics, and other branches necessary to the mechanic.

The establishment of like opportunities for instruction, is to be commended and encouraged elsewhere, whenever practicable.

If a young man sets out with a determination to get a better education, there is no reason why he should not succeed, if he only perseveres, or in homely words, "if he sticks to it."

Mechanical drawing is one of the most useful accomplishments which a mechanic can acquire, and there are several ways for a man to become a draftsman. He may study in an institute of technology; he may study in the drafting-room of a machine shop, or he may study drawing in his home, after his day's work is done.

There are several methods of getting at the chance to study, but *studying* is the only means by which a man can improve his education. A knowledge of mathematics, or any other branch of the sciences, can be acquired in the same manner, if the same application be made.

We recall an instance in which a young man received a good "common school" education, and "finished" by a three months' term in a country "high-school." In the shop and out of it, the necessity for a knowledge of mechanical drawing, became more and more apparent. An hour each evening was devoted to "studying drawing," and satisfactory progress made; patience and careful study conquering all the "tough questions" which came along.

About this time a chance came to attend an evening drawing school, in Lawrence, Mass., which was instructed by the same Mr. Colby, who is now at Rochester and connected with the school first referred to. The advantage gained by even limited attendance at an evening school was very encouraging.

Since that time, by constant study and every-day practice, the mechanic we have in mind has been able to do whatever drawing fell in his way, and can thank the "home-college" and the "evening school" for his education in that, as well as in some other branches.

If a young man wants to learn drawing, or anything else, let him set right at work studying the subject—and get the benefit of an evening school if possible.

Begin at the beginning, for a thorough practical knowledge of any subject. If a beginning is made "half way," the study is, at best, perplexing,—only half understood, and no solid practical knowledge is received for the time and labor spent.

Offensive and Defensive Preparations.

There is every evidence that the United States Government will, within the next ten years, expend a large amount of money in the construction of ironclads and coast defences. It is a problem of the first importance what the construction shall be in either case. Outside of this, a great number of heavy guns will doubtless be made. So little has been done here in these directions during the past twenty-five years that we are undoubtedly behind in knowing what to build. If, however, the Government expresses a willingness to examine plans, inventors will not be backward in presenting them. Then, again, there will be ample opportunity for the display of inventive talent in the design and construction of torpedo boats. All signs seem to point to the use of steel for offensive and defensive construction, even to forts, where earthworks are not practicable. Unquestionably, a good many skilled mechanics will find employment, directly and indirectly, in the processes of preparing for possible war. It is unfortunate that such expenditures are necessary; but moralizing over the matter will not alter the fact, and the country will be fortunate, if, in complications likely to arise at any time, it is not demonstrated that the delay in preparation has been too long. It is some consolation to know such an expenditure will have some good effect in helping along business, and in stimulating invention. Another pleasant thought is that a people thoroughly prepared for war are not likely to have it forced upon them.

Boiler Tests.

In connection with the efforts of the American Society of Mechanical Engineers to establish a standard for boiler tests, it is important to note the probable advantages to boiler users likely to result from frequent tests of their boilers made by their own engineers. While it is important that some standard should be universal amongst mechanical experts, so that the stated results shall always be understood and accepted, it would, in an economical point of view, be more important if some universal plan of testing boilers, and stating results, were in common use by every engineer who has them in charge. Such tests would aid in the selection of boilers, and be of much service in keeping them up to their average duty while in use. The best kind of coal to use under different conditions would not, as it too often is, be a matter of guesswork, and the effect of scale and dirt, in hindering steam-making, would be much better understood than it is now by those who are in positions to apply the remedy. Improvements in anything come, in the main, through the observations of the user; but with no recognized plan of test or generally understood terms of expressing results, the ordinary user of a steam boiler has but few means of making observations of any value. Boiler users would, if their boil-

ers were subjected to frequent evaporative tests by their engineers, find out what their economy was under ordinary management, which would be of much more value to them than to know the possibilities of expert management, and this knowledge would soon become generally known, to the advantage of steam users.

A test of the kind hinted at must be more simple than the ordinary expert test, and the results must appear without too much complication of calculations; hence the results would not probably be as scientifically accurate as an expert test, but would show probable, everyday results more accurately. It will be a good thing if the mechanical engineers finally agree upon a plan for boiler tests; it will be a better thing if boiler users devise a simple, practical plan in which the probability of error shall be small, and then make common use of it.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(36) F. N., Battle Creek, Mich., asks: What is the standard number of threads to the inch for brass tubing, or flues, or any pipe, when the outside diameter is used for all sizes of pipe? *A.*—See the AMERICAN MACHINIST of Jan. 2, 1886.

(37) J. J., St. Catharine, Canada, will find the information he asks for in the articles by Frank H. Richards on "Screw Cutting in the Engine Lathe." These articles appeared in the AMERICAN MACHINIST of Aug. 13 and 20, and Oct. 15, 1881, and April 4 and June 13, 1885.

(38) F. E. S., New York, writes: I have an 8″x12″ engine, and two fly-wheels, one of which I wish to use. The engine runs 160 revolutions per minute. One fly-wheel is 60″ diameter, and weighs 673 pounds; the other is 44″ diameter, and weighs 385 pounds. Which would you recommend to use? *A.*—The larger one.

(39) A. F. D., Philadelphia, Pa., writes: We have a plain slide-valve engine, 13½″x60″, running 45 revolutions, and doing 95 horse-power work; steam pressure, 90 pounds. Under the conditions named, at what speed will it be safe to run an 18′ fly-wheel? *A.*—If a well-made wheel, of good material, it should be entirely safe at 150 revolutions per minute.

(40) W. H. C., Worcester, Mass., asks: What is the difference between an eccentric and a crank? *A.*—An eccentric is virtually a cam, conveying motion with its whole circumference, while a crank may be defined as a mechanical device which may transmit motion by means of a single varying point in the circumference of the circle which it describes.

(41) J. P. G., Vineland, N. J., writes: We have barrels of water placed around our building to be used in case of fire. What is the best material to put into the water to keep it from freezing, and what effect will it have on fire? *A.*—Common salt is the best material, to our knowledge, for that purpose, and will materially assist in extinguishing the fire. By using coarse "agricultural" salt the expense will be very much reduced.

(42) G. L., Manitowoc, Wis., asks: Can I take condensed water in a coil heater and force it into boiler without the use of pump or steam trap? *A.*—That depends upon conditions not stated. If the heater referred to is above the boiler, and subjected to boiler pressure, the arrangement may be such that the water will flow to the boiler by gravity. If the heater is below the boiler, or not subjected to boiler pressure, some means, such as a trap, pump or injector, must be used to return the water.

(43) M. A. R., Hellertown, Pa., writes: Can you give me a rule for finding the different bevels of bevel gears? As, for instance, a man has a pair of bevel gears in his grist-mill; one has forty-four cogs and the other thirty-five cogs. If one breaks, how shall I know how to make a pattern? *A.*—We think if you will study the article by Geo. B. Grant, in the AMERICAN MACHINIST of Oct. 31, 1885, also articles in issues of June 24 and Aug. 30, 1884, you will find the information required.

(44) G. W., Jacksonville, Fla., writes: Can I make babbitt metal do for the slides of foot-power scroll-saws, instead of iron, the pitman to be of steel? *A.*—Babbitt metal will answer very well, but brass would probably give better satisfaction. 2. I have a strong foot-lathe, velocipede crank, and I wish to know how to get more power, in order to turn pieces 4′ long and 8″ in diameter? *A.*—You can get no more power from the lathe than you put into it. You can do large work either by applying more power to the treadles, or by back-gearing the lathe and then running the treadles at an increased speed. 3. Can you make it clear to me how Barnes' patent foot-power is made. I cannot understand it? *A.*—Write to the manufacturers, who will furnish you with the information you desire.

(45) J. B. C., Gouverneur, N. Y., asks: With what velocity per second will water flow into a condenser, supposing vacuum to equal 26 inches of mercury, and what will be the difference whether the water is taken from a well 25 feet deep, or from a supply on a level with the condenser? *A.*—Nystrom gives as a formula:

$$\text{Velocity} = 8\sqrt{2\,F \pm h}$$

or eight times the square root of twice the pressure per vacuum gauge less or plus the height of suction or head, as the case may be. Reducing 26″ of mercury to pounds of vacuum, which is

$$26 \times \frac{14.75}{30} = 12.78,$$

we may state the question as

$$2 \times 12.78 - 25 = .56$$

The square root of .56 = .74 +, and 8 × .74 = 5.92, the velocity per second with which a stream of water will flow into the condenser when the draft is 25 feet. With water on a level with condenser, the formula will be as above, except that the 25 feet draft is omitted, and we get

$$2 \times 12.78 = 25.56,$$

the square root of which is 5.05, and multiplied by 8 = 40.4 feet per second, velocity of admission with water supply level with condenser. In practice considerable variation will be caused by the size of the injection-pipe, which has not been taken into account in the above statements.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Power measured.–F. Van Winkle, 22 Cortlandt, N.Y.

T. M. Parker, Steel Stamps, Stencils, Hartford, Ct.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 48 Beekman st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

Steel Shank, Wire Nail, Shoe Nail and Tack Machinery. Keith & Trufant, Campello, Mass.

Tack and Wire Nail Machinery, made by the Willets Mfg. Co., Providence, R. I.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderbergh, Wells & Co., cor. Fulton and Dutch sts., New York.

Patent Attorney and Expert. Machine designs and details. Wm. H. Weightman, 82 Astor House, NY

Foot-power Machinery, for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Lyman's Gear Chart. How to Lay Out Gear Teeth. Price, 50c. E. Lyman, C. E., New Haven, Conn.

Second-hand Engine and Speed Lathes. Send for list to P. O. Box 1700, Boston, Mass.

Machines to form and bend steel and iron; run by power. Williams, White & Co., Moline, Ill.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

E. Merritt & Co., Brockton, Mass., established 1859, only manufacturers of a complete line of Tack and Nail Machinery. Send for circulars.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co., Collinsville, Conn.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Jan. 2, p. 13. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-taught," $4. Books for workmen. Joshua Rose, Box 3306, New York City.

For Sale—One 50 H. P. and one 200 H. P. Corliss engine, built by Geo. H. Corliss; also one 30 H. P., Erie City Iron Works portable engine and boiler, nearly new, used but a few months. Henry I. Snell, 135 North Third street, Philadelphia, Pa.

"Locomotive Engine Running and Management." By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air-brake explained by aid of engravings. Price, $2. For sale by "National Car Builder," 187 Dearborn st., Chicago, Ill.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo. edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent. on orders for five or more copies.

MANUFACTURES

The Chicopee Falls, Mass., Screw Co. is to start its works at once.

A large addition is to be built to the Government gun factory, Watervliet, West Troy, N. Y.

A new foundry, 80x300 feet, is being built in Allegheny, Pa., by the Pittsburgh Locomotive Company.

The Knights of Labor contemplate erecting a foundry at Spring City. It will be conducted on the co-operative plan.—*Iron.*

The Long Island Railroad Company has purchased 250 acres of land at Islip, L. I., and will erect new buildings there.

The Elliott Motor Company, capital stock $100,000, incorporated at Mobile, Ala., will build a factory at that place.—*Manufacturers' Record.*

Frasse & Co., 62 Chatham street, have been appointed New York City agents for the sale of Chas. P. Fay's spring calipers and dividers.

McGinty's machine shops, at Athens, Ga., that employed sixty men, will be rebuilt at once, and will put in new and improved machinery.

The firm of Geo. A. Ohl & Co., East Newark, N. J., has been dissolved by limitation, and "The Newark Machine Tool Works" succeeds to the business.

The Worcester (Worcester, Mass.) Steel Works, which have been shut down for several weeks on account of an accident, will start up in a short time.

The Industrial Works, of Dushore, Pa., are very busy, having orders ahead to last three months. They talk of building an addition to their machine shop in the spring.

The "Square Hole Auger Company" is the singular title of a company which is fitting up shops in Worcester, Mass., for the manufacture of "augers to bore square holes."

The Hall Steam Pump Co., 96 Liberty st., N. Y., were awarded a silver medal of the Franklin Institute for duplex steam pumps at the late "Novelties" Exhibition at Philadelphia.

Sloan, Chace & Co., Newark, N. J., have issued an illustrated circular of their No. 5 machinists' bench-lathe. It contains a description of the lathe, and price-list of lathe and a large variety of fixtures.

According to *New Enterprises*, the Holmes, Booth & Hayden Co., Waterbury, Conn., the Seymour Mfg. Co., Seymour, Conn., and the Winchester Arms Co., New Haven, Conn., are to build additions to their works.

The steel rail mill connected with the Vulcan Steel Works, St. Louis, is to be started up immediately to its full capacity, 500 tons daily. This mill is outside the combination of steel rail makers, and has a large number of orders.

It is reported that the Smithville Manufacturing Company's mill at Willimantic, the machinery of which has been idle since last spring, has been bought by Tarbell & Harris, of Woonsocket, R. I., cotton manufacturers, who will at once start the machinery.

The Brierfield Coal and Iron Company, Brierfield, Ala., who are remodeling their furnace so as to make coke instead of charcoal iron, expect to be able to blow-in about Feb. 1. The same concern is now laying a two-mile railroad from Brierfield to the old Bibb Furnace.

According to the daily press, the iron masters of Lancashire, Eng., have notified their workmen that, owing to the great depression in the iron trade, they are compelled to make a general reduction in wages. It is expected the workmen will resist the reduction, and a strike is looked for.

The White Mountain Freezer Co., Nashua, N. H., are altering their buildings to increase their safety in case of fire. The production is increased about two and a-half times, besides doing much better work. They consider the outlook good, and will increase their production for 1886 about thirty-three per cent. over 1885.

According to a press dispatch from St. Paul, Minn., a company of Eastern capitalists is to be organized to build a large number of grain elevators along the lines of railroad in North Dakota. The elevators are to be run on a novel plan, viz., keeping each farmer's wheat separate, and loaning money to farmers on wheat carried.

Hundreds of new men have been taken on at the Rogers Locomotive Works of Paterson, N. J., and the establishment is put on full time for the first time in a long while. Thirty-six engines are laid out for the coming three months, just double the number of the preceding quarter. There is also a great increase in the manufacture of machinery and of silk, and there is every appearance of the advent of better times.—*N. Y. Sun.*

We are in receipt of a circular from E. M. Goddard, Holyoke, Mass., describing a gas regulator of his invention. It consists of a valve to reduce the gas pressure to the desired point, which is actuated by the pressure of gas moving a diaphragm attached to the valve-stem. This diaphragm is separated from the gas by an air-chamber and a glycerine seal, which effectually prevents any leakage of gas.

The Beckett & McDowell Mfg. Co., New York, report plenty of orders on hand. They have just received an order from Chili for twenty-five tons of crushing machinery, following a plant of 100 tons shipped early in 1885. They have also an order from Mexico for 150 tons, on which they are shipping a car-load a week. They have just shipped a large ice machine to Cincinnati, and another to Bridgeport, and have orders for five more on hand, while reporting an increased demand for mining machinery.

Pedrick & Ayer (L. B. Flanders Machine Works), Philadelphia, write us that their valve-seat rotary planing machine, while designed more especially for facing the valve-seats of locomotives and stationary engines, has been adapted, with but slight alteration, to several new uses, one of which is in the manufacture of large stops for water-main work. W. F. Courtney, superintendent of shops, Philadelphia Water Department, has written them describing the very effective work of the machine employed for this purpose under his direction.

Samuel T. Williams (Engine Builder and Machinist), Baltimore, writes us: "My business, at times, has been so great that my old quarters became too small, and I removed to a large building at 167 North street last summer, where, with improved facilities and ample room, I have been able to do more and better work. I have done work in the new place that I could not get into the old place. I have had no booms, but managed to keep pretty busy, and believe the next year will show a decided improvement. My engine seems to be giving satisfaction."

The Gordon & Maxwell Co., Hamilton, Ohio., write us: "We are as full of business as ever in the history of our pump works. We contemplate some considerable additions to our buildings this year, besides re-arranging our pattern storage and switch arrangements, to make them more convenient. We have put in electric lights and overhead travelers, and a large number of machines for the purpose of more perfect workmanship and rapid production in our duplex pumping machines, so that we are now better fixed for the manufacture of steam pumps than any other concern in the country."

E. Gould & Eberhardt, Newark, N. J. (Machine Tools), write us: "Our business for 1885, has been quite fair; have worked full time, with a fair complement of hands. Prices were reduced some to meet the close competition, although prices of labor have not changed. We have improved our productions in various ways, and are meeting with success wherever they are sent. Eberhardt's automatic gear cutter is being adopted by the leading tool builders and other leading manufacturers East and West, and the new drill press is also making friends. Orders for our patent shapers, gear cutters, etc., are being placed more readily than before, but prices are too close, compared with cost. The buyer has the best chance now; the seller may have shortly."

The Yale & Towne Mfg. Co., Stamford, Conn., write us: "In your issue of November 28, 1885, the question is asked as to who makes flexible tubing capable of standing hydraulic pressures from 2,000 to 5,000 pounds per square inch. In reply, permit us to say that a system of pipes, flexible at their joints, has long been used by us in connection with the Emery hydraulic testing machines, under quite high pressures, and with entire success. As we use them for this purpose the sections are from six to ten feet in lenth, but they can, of course, be made shorter, as required for any special purpose. The description of the Emery testing machine at the Watertown Arsenal, in your issue of July 21, 1883, contains a description and small illustration of our patent system of joints for flexible piping."

The Stiles & Parker Press Co., Middletown, Conn., write us: "Our business for 1885 was better than 1884. The indications with us are that there is a steady improvement in business, and that it has come to stay. Prices have been very low, and we think that the improvement in business warrants us in advancing prices, which we have done, with the issuing of our new catalogue, to a limited extent. We have put up no additional buildings, and have put in but few new tools. We have sold a few of our old tools, and replaced them with new ones. The experiment of opening a branch shop and salesroom in New York city has proved a profitable investment. We have all we can do, and are called upon for more tools, which we are adding from time to time. In our line of business it is quite necessary to come in contact with our customers, especially in getting out new and special machines. People come to New York who cannot conveniently go to Middletown. We have made many new customers and friends in this new enterprise. During the past year we have got out a new line open-back presses, which we furnish either upright or on the incline, and have also got out a new line of adjustable incline presses, which we call the 'center-swing press.' For the last three months we have been running our factory at Middletown thirteen hours per day on die work. We are making for one party about 200 dies, and this, with the other work on hand, has compelled us to put on more help and increase the number of working hours, as stated above. We are making good progress with our new drawing press, using the toggle-joint to operate the block holder, which arrangement insures the block being held under uniform pressure during the whole duration of drawing, the wearing of the parts having no effect, as is the case where the block holder is operated with cams. We expect in a short time to have a full line of these presses ready for the market."

Machinists' Supplies and Iron.

NEW YORK, Jan. 13, 1886.

The market has nearly recovered from the excitement of the past few weeks, but the recent advance in ore is fully sustained. Manufactured iron has not yet made an advance equal to that of pig iron, but ore has fully kept pace in the increase of price.

American Pig—There has been no urgency to sell; the market has ruled quiet and business has been confined to small buyers. We quote Standard Lehig and North River brands at tidewater $18 to $18.50 for No. 1 X Foundry, $17 to $17.50 for No. 2, and $16 to $17 for Grey Forge.

Scotch Pig—The market is easier. prices are not quotably lower, but the market is in the buyer's favor. We quote Coltness, $19.50 to $20; Glengarnock, $18.50 to $19, to arrive; Gartsherrie, $19 to $19.50; Summerlee, $19 to $19.50; Eglinton, $17.50 to $18; Langloan, $19.50, and Dalmellington, $18.25.

Lead—Dull, 4.62½c., spot; 4.65c. future delivery.

Copper—No quotable change; values firm; Lake, 11⅝c. to 11¾c., cash.

Tin—Dull and flat; Banca, 21½c.; Straits and Malacca, 20.55c., cash.

Spelter—Easier; refined, 5⅜c. to 6c.

Antimony—Hallett's, 8½c.; Cookson's, 9½c.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Traveler wants engagement to make occasional trips to push sale of special tools, mfr's. supplies, etc. Traveler, care AM. MACHINIST.

Pattern-maker, good general hand, wants job; city or country. Address T., AM. MACHINIST.

Wanted—Situation as supt. of engine and machine works; references covering 25 years' experience. Address, Wallace, 358 W. 11th st., N. Y.

Wanted—Superintendent for engine works; state reference, experience, age, salary expected. Address, Hyatt, 131 Charles street, New York.

Machinery Salesman—Practical machinist desires position as salesman; has had good experience as such; can give best of references. Address, B. W. J., AM. MACHINIST.

A thorough and practical mechanic, of 20 years' experience, desires a situation as foreman or superintendent of a machine shop. Address, Box 60, Gloucester City, N. J.

Wanted—Situation as draftsman or assistant engineer, by one who has had technical education and practical experience; no objection to distance. Address, Q., AM. MACHINIST.

Wanted—Situation as foundry foreman; large experience in machinery and steam work, management of men, and mixing of metals; good references. Address Moulder, 424 12th st., Chicago, Ill.

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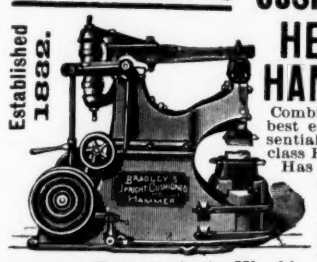

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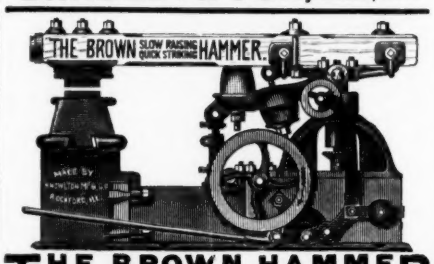

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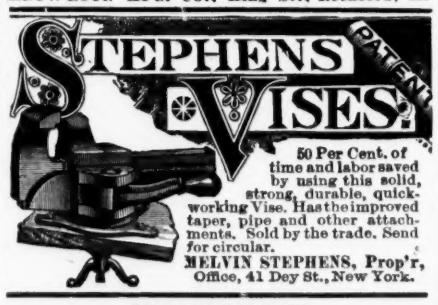

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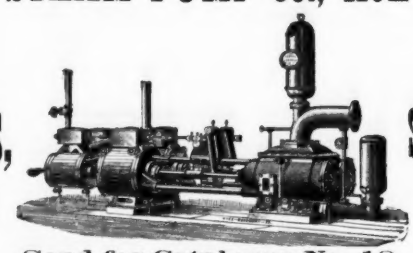

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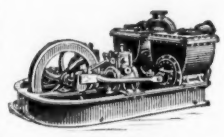

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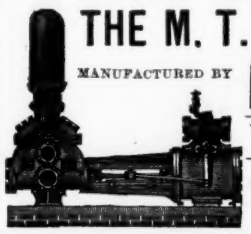

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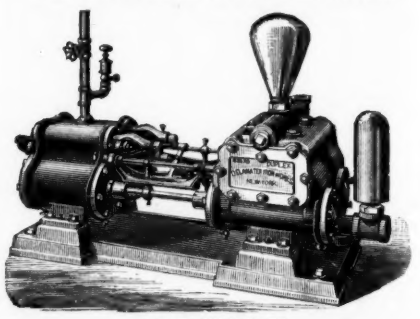

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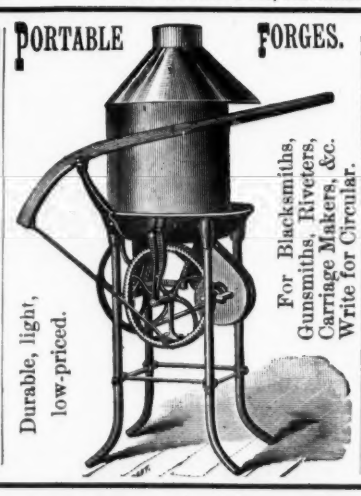

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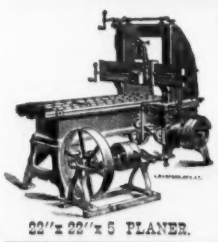

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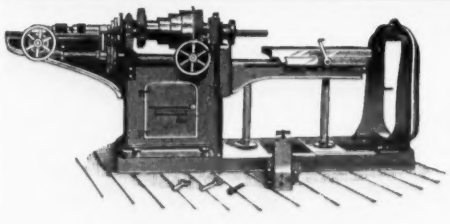

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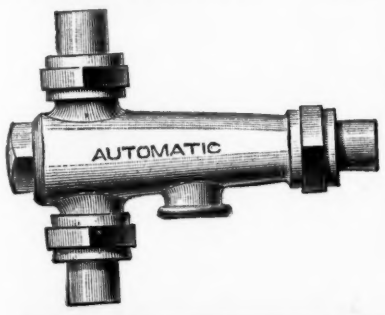

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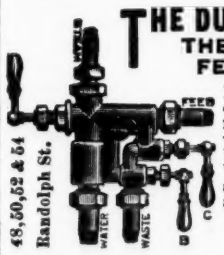

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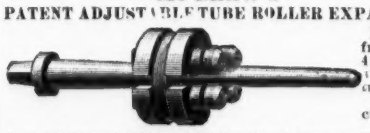

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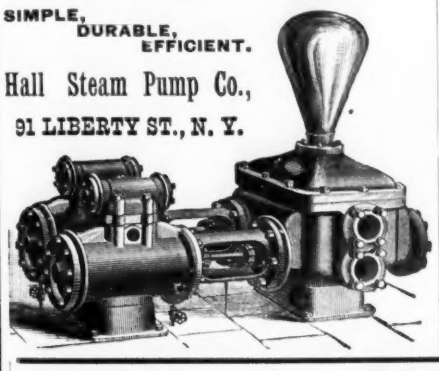

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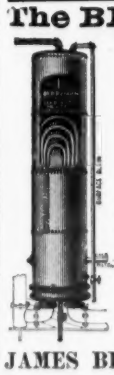

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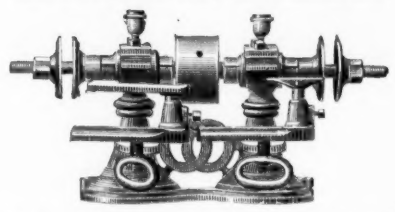

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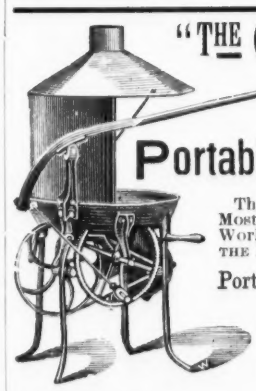

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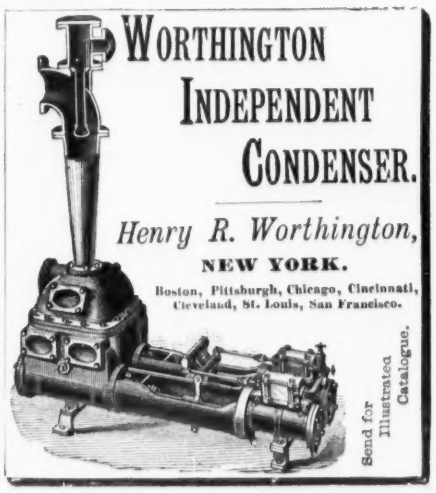

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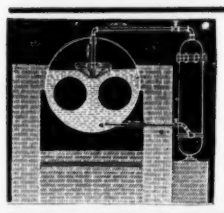

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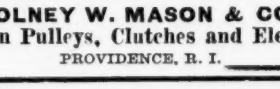
ISSUED Feb. 24,  Aug. 18, 1885.

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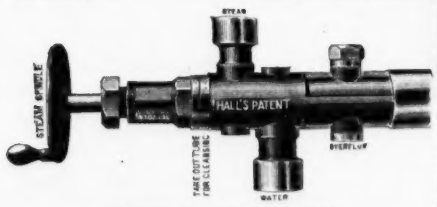

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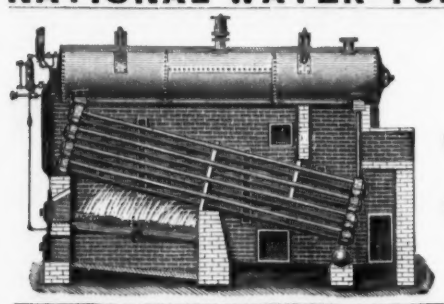

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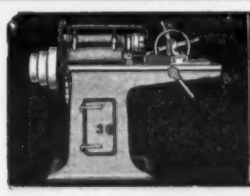

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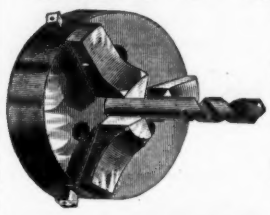

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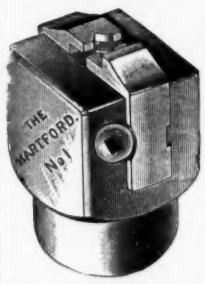

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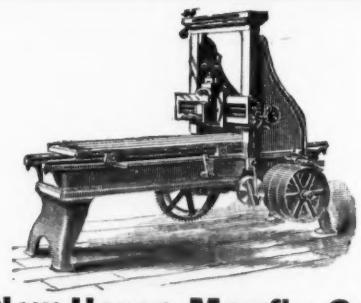

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George Escol Sellers.

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John W. Nystrom.

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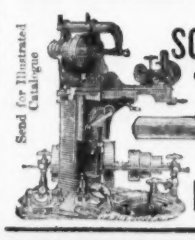

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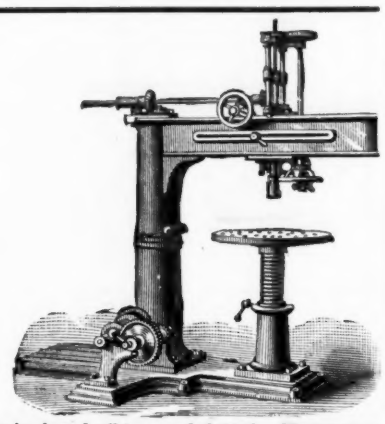

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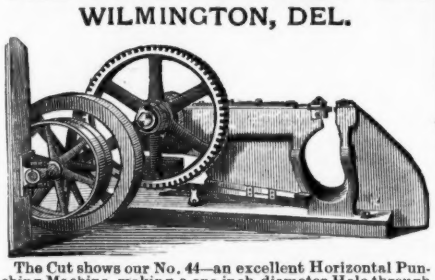

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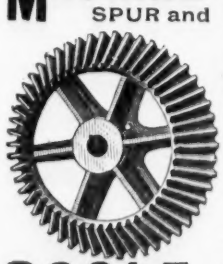

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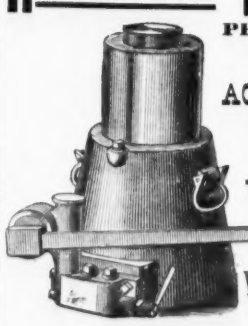

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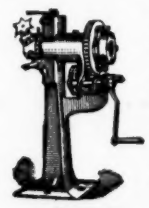

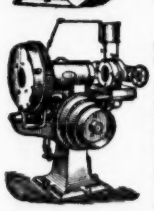

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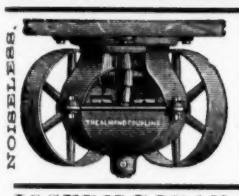

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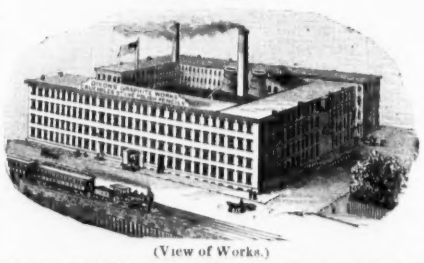

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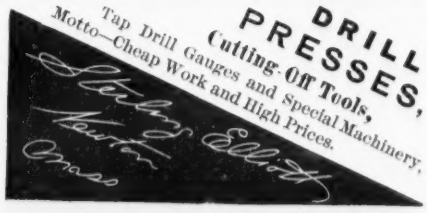

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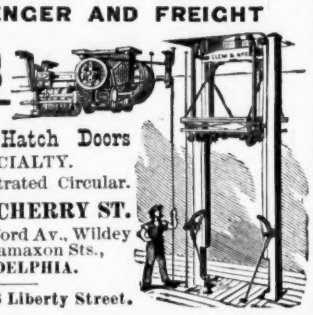

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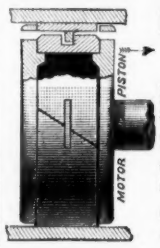

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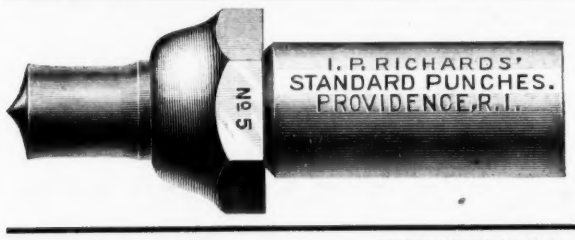

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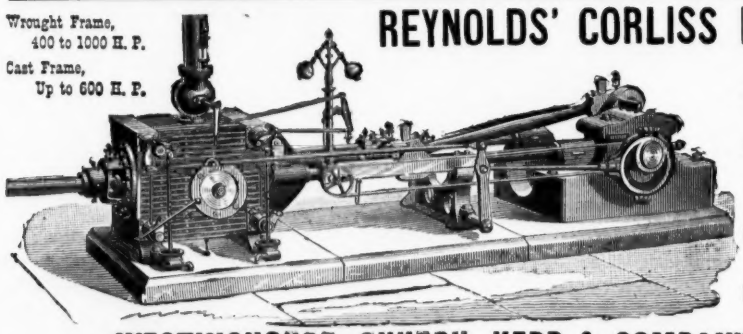

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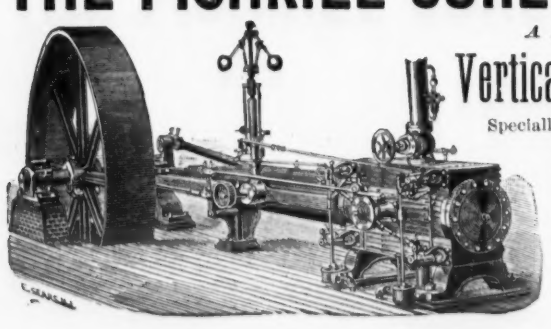

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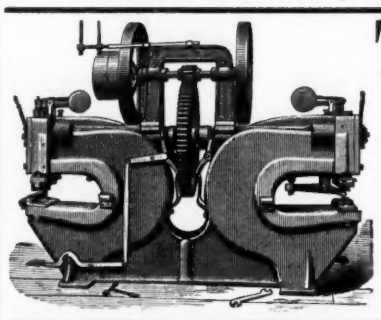

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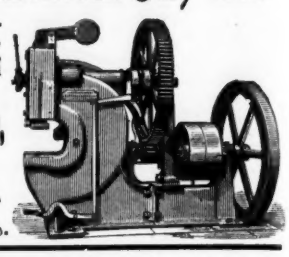

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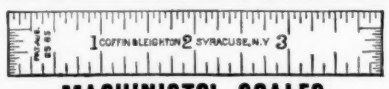

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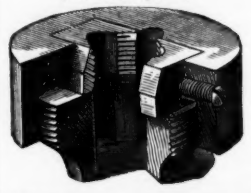

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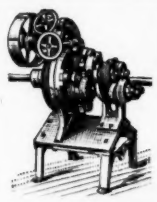

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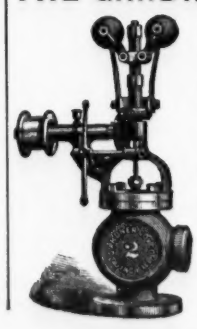

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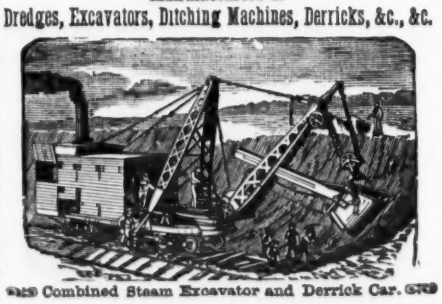

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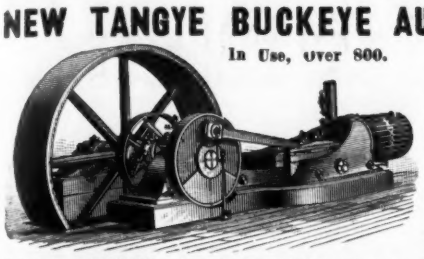

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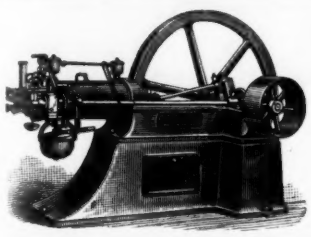

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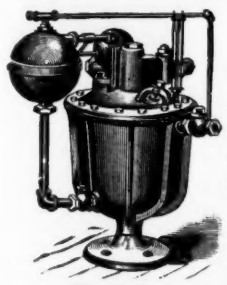

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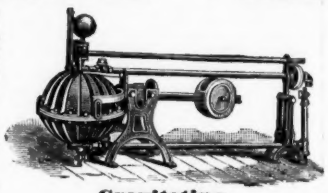

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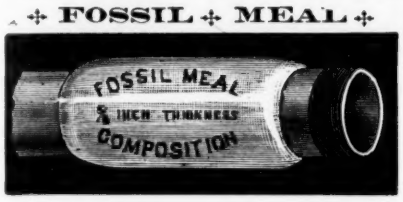

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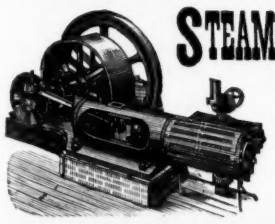

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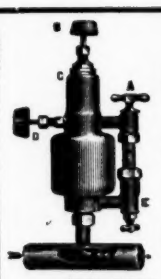

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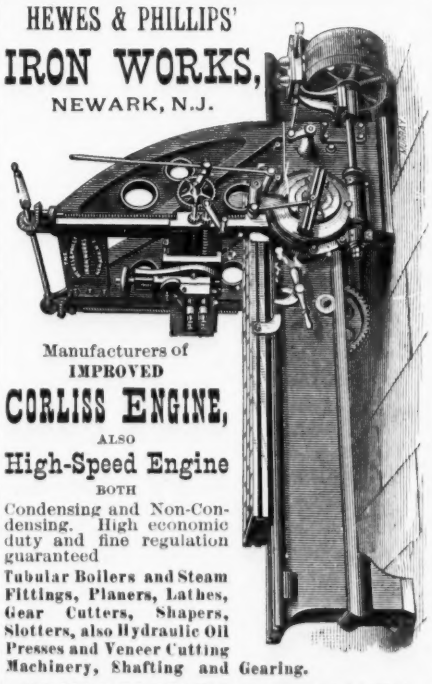

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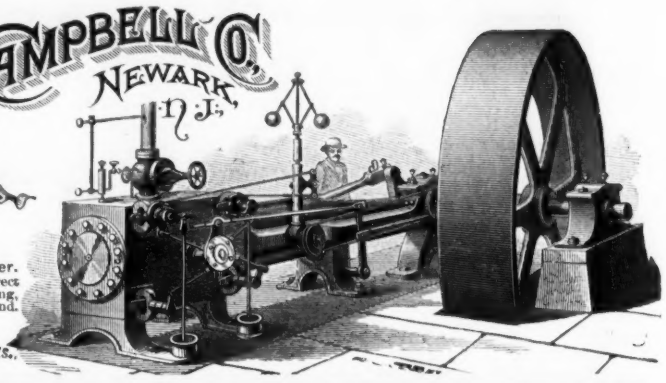

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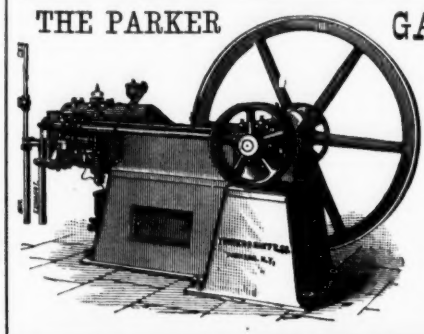

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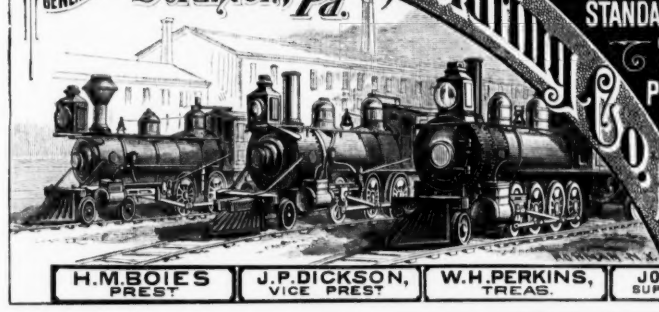

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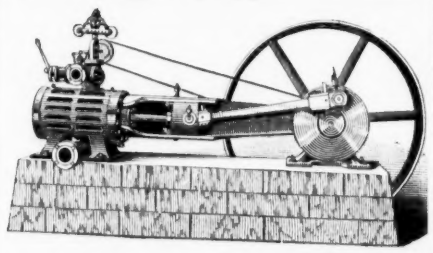

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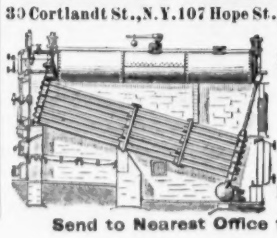

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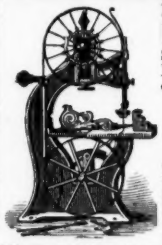

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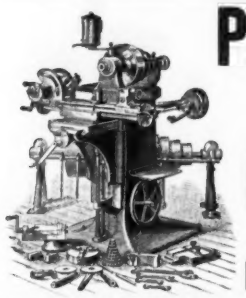

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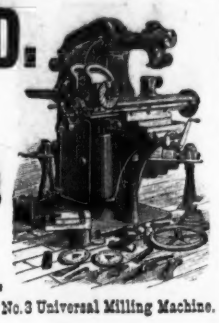

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Are kept in stock and sold at favorable prices, compared with any of their **IMITATIONS.** *By making these Machines in large numbers, with expensive special tools, much greater accuracy has been attained than can be reached by the usual methods of manufacture. The importance of the greatest attainable accuracy in* **TOOL-MAKING MACHINES** *will be appreciated by Machinists.*

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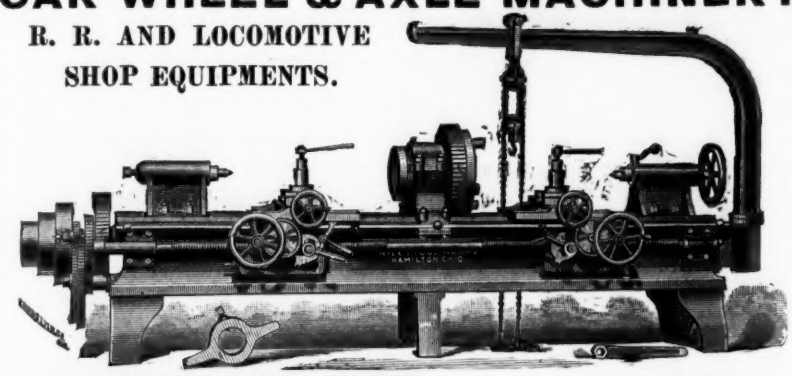

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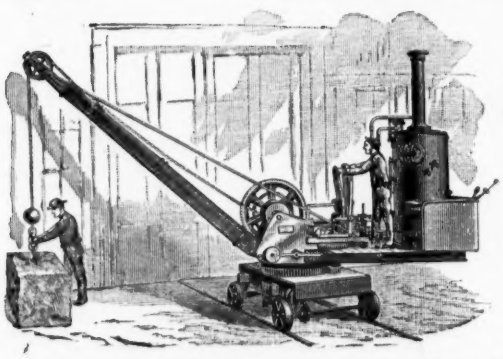

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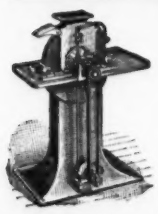

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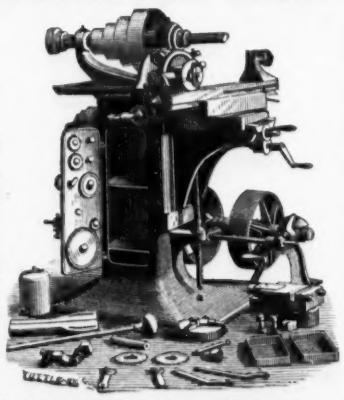

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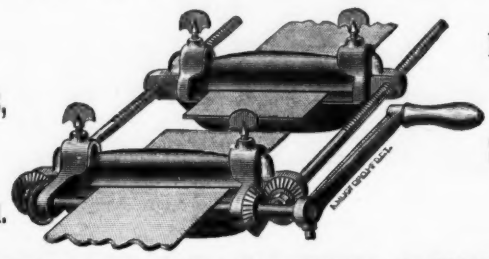

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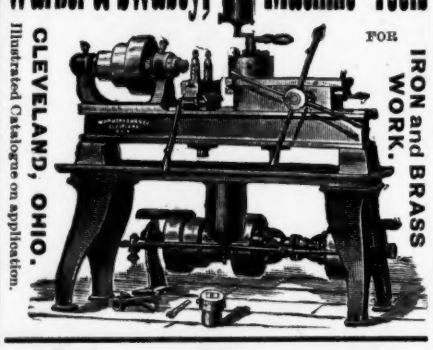

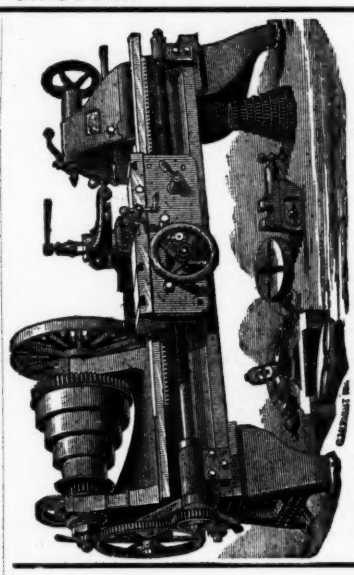

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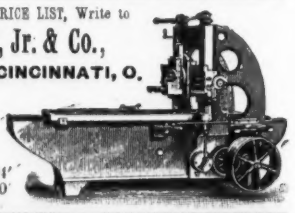

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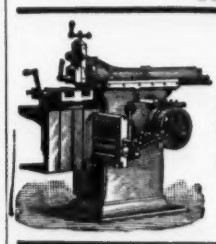

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